Chapter 4 The economic framework

4.1 Introduction

This chapter sets out an economic framework to assess the impacts on the cattle and beef industry of productivity changes in the meat processing industry. Section 4.2 provides a discussion of the nature of marketing margins for farm products, the causes of changes in marketing margins and the incidence of those changes. This analysis of marketing margins provides the framework for assessing the potential impact on participants in the cattle and beef industry and consumers, in terms of the direction of changes in supply and demand and the distribution of benefits, of lower costs in the meat processing industry due to labour market reforms. A diagrammatic analysis is used to illustrate this framework. A brief discussion of the potential causes and effects of delays in adjustment processes is also given. Section 4.3 provides a more formal algebraic discussion of the economic framework, focusing on the potential impact of input substitution in determining how gains from supply and/or demand shifts in multi-level production systems are distributed.

4.2 Marketing margins in a diagrammatic framework

4.2.1 The nature of marketing margins

Between the farm gate and the final consumer, food products can be considerably transformed. The extent to which this occurs will vary between products, with products such as eggs and fresh vegetables undergoing relatively little, if any transformation, and products such as meat undergoing considerable processing along the marketing chain. The range of services that add value to the raw primary product include processing, grading, packaging, transport, retailing and storage. These activities reflect consumer demand for product attributes such as product form, timeliness to market and distribution of goods.

The process of adding value to the raw primary product will cause farm and retail prices to diverge. While there is clearly a relationship between changes in farm and retail prices, this relationship is not perfect. That is, while any change in the price of one input into any aspect of the marketing chain might affect demand or prices facing providers of other inputs to the industry, the relationship between these inputs may vary depending on the extent of competition, time lags in adjustments and the presence of substitutes.

The impact of potential changes in labour costs in the meat processing industry is examined in this section using an analysis of changes in the farm-retail price spread, or marketing margin. This analysis draws on the discussion of marketing margins in Tomek and Robinson (1990) and Campbell and Fisher (1991).

Tomek and Robinson define marketing margins in either of two ways: (a) as the difference between the price paid by consumers and that obtained by producers; or (b) as the price of a collection of marketing services that is the outcome of the demand for and supply of such services.

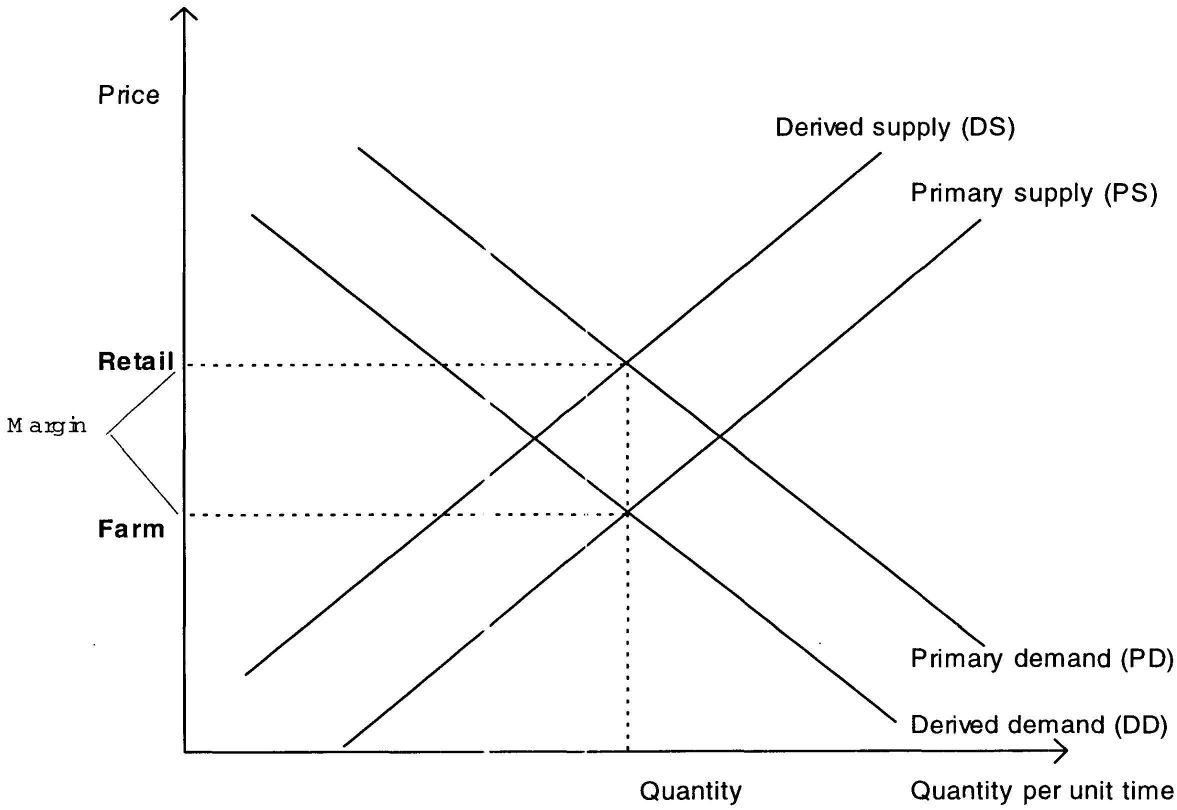
Using the first definition, marketing margins are the vertical difference between the primary and derived demand curves for a product. Primary demand is the demand for the product by ultimate consumers. It is estimated using retail price and quantity data. Derived demand is the demand at the farm gate, or at other intermediate points in the marketing chain such as the purchase of goods by wholesalers or processors. In other words, derived demand is the demand for the inputs used to produce the final product. For example, the demand for wheat used to make bread is a derived demand. Similarly, the demand for livestock is derived from the final consumer demand for meat products. Derived demand can change either because of a change in primary demand or because of a change in marketing margins.

Primary demand can be described as a joint demand for all inputs in the final product. For example, food products can be conceptually divided into two input categories - a farm component and a processing/marketing component. Under some simplifying assumptions, derived demand for the farm product is obtained by subtracting the per unit costs (prices) of all the processing/marketing components from the primary demand function. The demand at the farm level is therefore the derived demand for the farm component of the final product. The simplifying assumptions are that the final product is made from fixed proportions of the inputs, and that the supply of marketing inputs is perfectly elastic. Fixed proportions implies that the elasticity of substitution between the farm and non-farm inputs is zero (Tomek and Robinson, 1990). Specifically, the conditions under which fixed proportions can occur are if the supply of inputs are perfectly elastic (ie. processors can purchase more labour and capital without bidding up their price), if it is not possible to change the proportions in which inputs are used and if the processing sector is competitive. Under these conditions, processing costs are the same for all levels of output (Griffith and Mullen, 1991).

Primary supply functions refer to the supply relationship at the producer level and, conversely, derived supply refers to the supply at the retail level. Figure 4.1 illustrates these concepts of primary supply and demand and marketing margins.

The retail price is the price that prevails where primary demand and derived supply intersect. The price at the farm gate is determined by the intersection of derived demand and primary supply. The marketing margin is the difference between the two prices.

Figure 4.1 Primary and derived functions and marketing margins



Source: Tomek and Robinson (1990, p. 109)

The alternative definition of a marketing margin given by Tomek and Robinson is that it is the price of a collection of services, such as transporting, processing and packaging. Marketing margins under this definition would depend on the particular demand and supply relations for all such services. The extent to which margins vary between products depends on the number of services involved and the relative complexity of the processing being undertaken (Campbell and Fisher, 1991).

4.2.2 Changes in marketing margins

Marketing margins will change over time because of both short and longer term factors. In terms of longer-term trends, it has been observed that marketing margins for agricultural products tend to widen over time, and consequently, the farmer's share of the consumer's dollar tends to decline. One explanation for this is that marketing services tend to be more labour intensive than the farm input into the final product. This means that the cost of marketing services will rise faster than the costs of farm production. In addition, there may exist technical difficulties which limit opportunities for substitution of machinery and equipment for labour (Campbell and Fisher, 1991).

Another explanation for this declining trend in the farmer's share of the consumer dollar is that, as incomes grow and standards of living improve, consumers tend to demand more marketing services as part of the final product they buy. For example, consumers may be willing to pay more for pre-packaged, frozen, or partly prepared meat products as their income increases.

In the short term, margins may vary due to changes in the costs of marketing inputs, such as labour costs, as well as because of changes in the volume of products moving through the market. However, Campbell and Fisher note that margins for food products tend to be relatively stable in the short term. This is largely because wages, which account for a significant proportion of the margin, tend to be quite stable relative to the prices of unprocessed farm products.[17] This 'stickiness' of margins has meant that the farmer's share of the consumer dollar increases when, for instance, cattle prices rise and decreases when cattle prices fall.

Another possible cause of 'stickiness' in margins for food products, including meat, is the use of price levelling and averaging by wholesalers and retailers. Price levelling is the practice of wholesalers (retailers) holding their selling prices relatively stable despite changing auction (wholesale) prices. Price averaging is the practice of setting a low spread on one product and recovering

[17]This is particularly so for perishable products, such as meat and fruit, with highly volatile prices.

any losses by setting a higher spread on other related products (for example, different meat types). These pricing practices smooth the impact on consumer prices of supply and demand changes in the markets for farm inputs and marketing services. Parish (1967) argued that the welfare effects of price levelling and averaging may be favourable as consumers prefer relatively stable prices. In a study of the Sydney meat market (beef, lamb and pork), Griffth et al., (1991) found that price levelling occurred at both wholesale and retail levels for all meats in the short term (up to one month). However, the study found no evidence of price averaging in any of the meats.

Marketing margins change when primary and derived supply and demand change relative to each other. Derived demand and supply curves shift when the cost of the marketing services that make up the final product change. The shift in derived demand may not be parallel if the change in the cost of marketing services is due to structural factors, such as new processing technology. The supply curve may shift due to either price or yield risk (Tomek and Robinson, 1990).

Primary demand shifts when new services are included in the final product. For example, new packaging of meat products uses a different combination of inputs, effectively creating a new demand curve for a different final product. Adding new services typically increases demand, shifting the primary demand curve up and to the right.

In summary, changes in margins occur due to changes in input prices, efficiency and due to changes in the services embodied in the final product. Over the long run, margins tend to parallel cost changes, which in turn tend to be "sticky" relative to farm prices (Tomek and Robinson, 1990).

4.2.3 *Incidence of changes in marketing margins due to labour market reform in the meat processing sector*

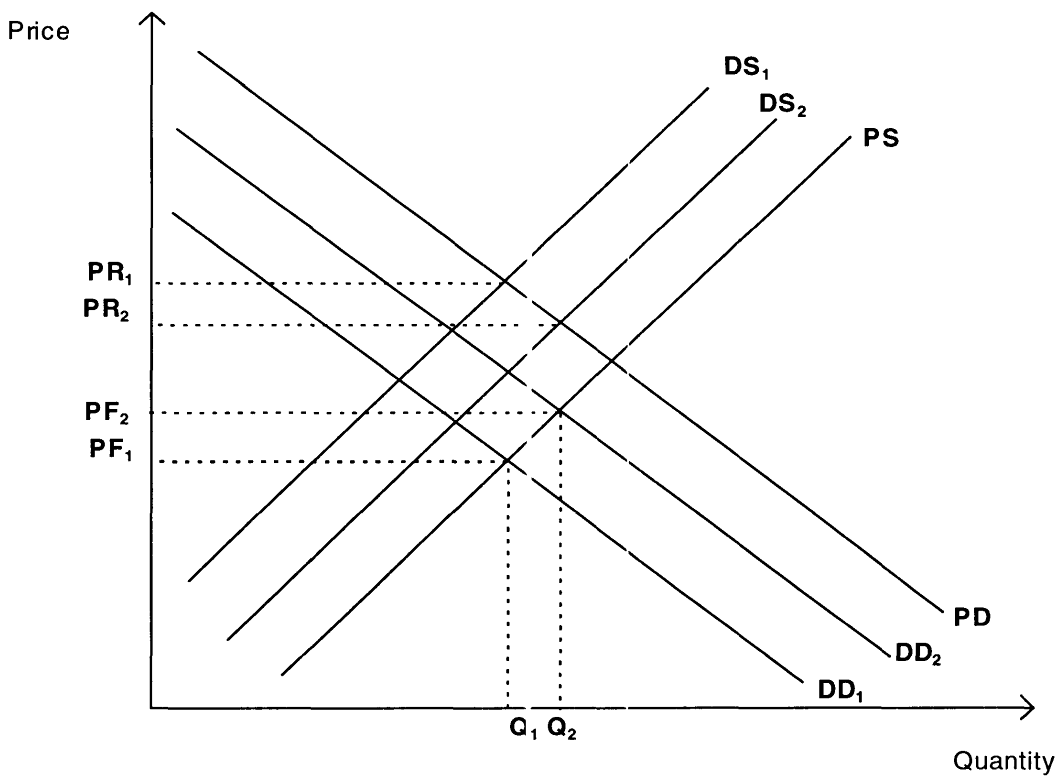
The particular change in 'marketing services' analysed here is the forecast reduction in meat processing costs due to implementation of the labour market reforms discussed in the previous chapter. These reforms are outlined in studies by the Industry Commission (1994) and Booz Allen and Hamilton (1993). In particular, these reductions in labour costs reflect the removal of the tally system of remuneration that applies under the Australian meat industry awards, and moves to 'best practice' labour productivity levels as determined by comparison with New Zealand abattoirs. The 'incidence' of this change refers to the distribution of the benefits of lower processing costs between meat processors, livestock producers and consumers.

Campbell and Fisher (1991) note that there are two basic determinants of how lower processing costs are distributed in a competitive market. The first is the way in which consumers react to any change in the retail price of meat products (the price elasticity of primary demand). The second determinant is the way in which livestock producers respond to changes in prices at the farm gate (the price elasticity of primary supply). It is the interaction of supply and demand that will determine how the benefits of lower processing costs are distributed between producers and consumers.

A third determinant is the nature of the relationship between primary and derived demand and supply. If these curves are parallel, the supply of marketing services is perfectly elastic and processors do not retain any of the benefits of reform. Alternatively, if these curves diverge with increasing output, the supply of marketing services is less than perfectly elastic and processors are able to appropriate some of the benefits of reform. This situation is illustrated in Figure 4.5.

Tomek and Robinson (1990) argue that both retail and producer prices are likely to change when the cost of producing an existing set of marketing services changes. This is because the cost change is reflected as a change in both derived supply and derived demand. A decrease in marketing margins due to lower meat processing costs would be reflected in an increase in derived supply and in derived demand. In other words, the supply of meat products at the retail level would increase and the demand for livestock as an input into meat processing would also increase. As a result, the retail price of meat products would be expected to decrease and the farm gate price of livestock to increase. This process of adjustment to lower meat processing costs (due to enhanced labour productivity) is illustrated in Figure 4.2.

Figure 4.2 Impact of lower processing costs on farm and retail prices



For convenience, this analysis assumes a competitive processing sector market structure, and therefore, that changes in marketing margins are reflected through the entire marketing system. In other words, all savings are passed on as the processing sector cannot appropriate any of the benefits from lower costs.

The above graph shows that lower processing costs due to a reduction in labour costs translate into an increase in the derived supply of meat - DS_1 shifts outward to DS_2, causing the retail price of meat to decline from PR_1 to PR_2. The derived demand for livestock also increases - DD_1 shifts right to DD_2, resulting in an increase in the farm price of livestock from PF_1 to PF_2. The output of meat products increases from Q_1 to Q_2.

The incidence of the change in meat processing costs, or the distribution of the cost reduction, between producers and consumers will depend on the relative elasticities of supply and demand. The steeper (more inelastic) the demand curve is relative to the supply curve, the greater the proportion of the decrease in processing costs received by consumers. The steeper supply is relative to demand, the greater the impact on farm prices compared to retail prices. This is the conclusion of Freebairn et al. (1982), who demonstrated that the share of a change in margins borne by producers, processors and consumers is determined by the price responsiveness of their respective supply and demand curves. The less responsive (more inelastic) the group is to changes in price, the greater the proportion of any increase in cost they will bear and, conversely, the greater the share of any benefits from lower costs they will receive.

The benefits to consumers and producers flowing from a change in processing costs can be assessed in terms of changes to producer and consumer surplus. Producer surplus is the difference between sellers' aggregate actual market receipts and the minimum receipts at which they would have been willing to offer the good for sale. Consumer surplus is the difference between buyers' aggregate 'willingness to pay' and the aggregate total they must actually pay in the market for a good (Hirshleifer, 1988). It can be understood as the money saved from the consumption (Zhao et al., 1995).

The impact of lower meat processing costs on the cattle and beef industry under different supply and demand elasticity scenarios is illustrated diagrammatically in Figures 4.3 and 4.4.

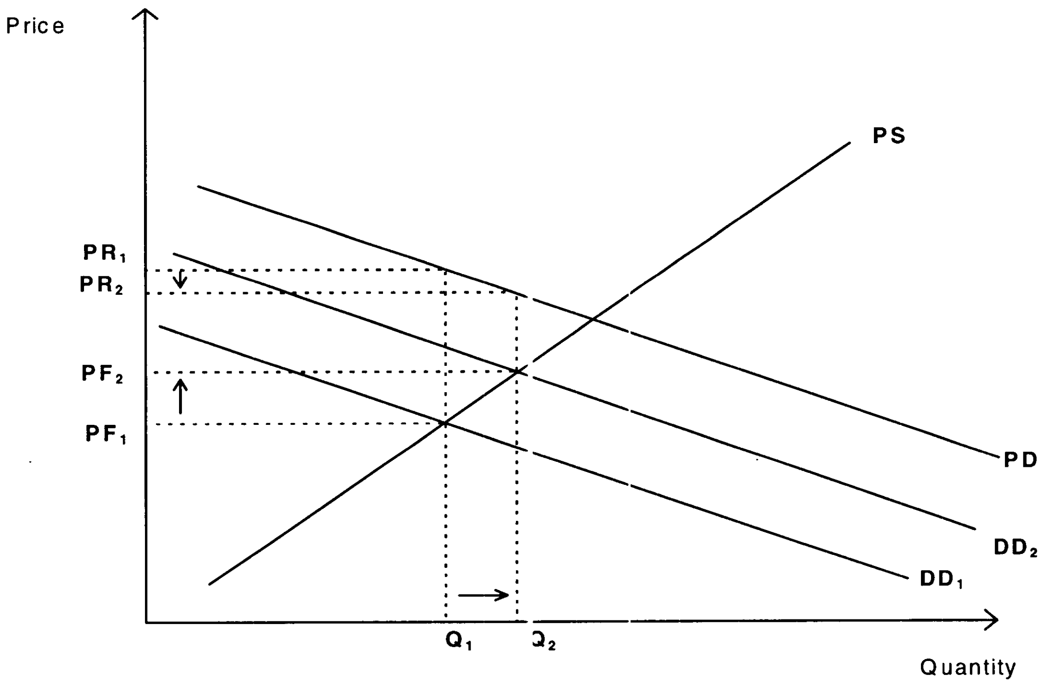
In Figure 4.3, primary supply is assumed to be fixed in order to illustrate the impact of different demand elasticities on the incidence of a change in marketing margins. In Figure 4.3(a), the primary and derived demand curves are relatively elastic. The reduction in processing costs flows through to a decrease in the retail price of meat products from PR_1 to PR_2 and to an increase in derived demand for livestock, shown as a shift from DD_1 to DD_2. This causes the price received for livestock by farmers to increase from PF_1 to PF_2. Output increases from Q_1 to Q_2. The decrease in retail prices is smaller than the increase in the farm price, showing that, with elastic demand, livestock producers receive a greater share of the benefits of a reduction in processing costs than do consumers.

In Figure 4.3(b), demand is assumed to be relatively inelastic. Under this scenario, consumers receive a greater share of the benefits of processing cost reductions than do farmers as the decrease in retail price from PR_1 to PR_2 is greater than the increase in the farm price from PF_1 to PF_2.

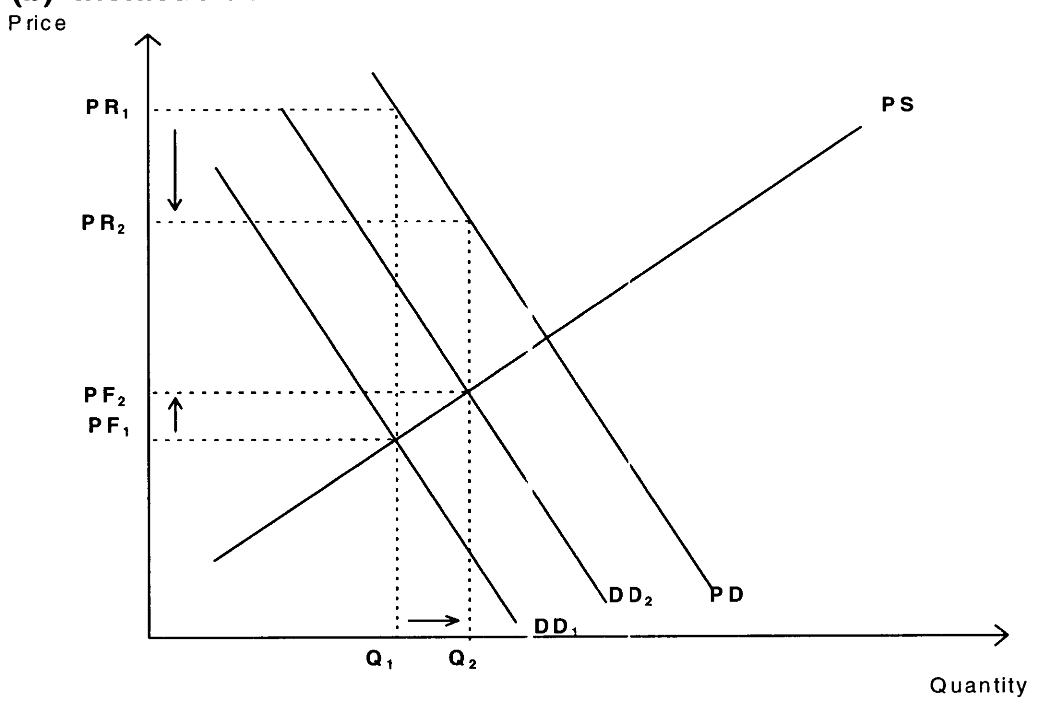
In summary, the more elastic is demand, the greater share of the cost reduction is received by livestock producers rather than by consumers. Conversely, the more inelastic is demand, the more consumers benefit relative to livestock producers.

Figure 4.3 The distribution of lower processing costs under different elasticities of demand.

(a) Elastic demand



(b) Inelastic demand



In Figure 4.4, primary demand is assumed fixed to illustrate how different elasticities of supply affect the incidence of a change in processing costs. In Figure 4.4(a), primary and derived supply is assumed to be relatively elastic. With lower processing costs, derived supply of meat products increases from DS_1 to DS_2, causing the retail price to fall from PR_1 to PR_2. The resulting increase in demand for meat products and livestock causes the farm price to increase from PF_1 to PF_2, with quantity increasing from Q_1 to Q_2. Under the elastic supply scenario, the decline in the retail price as a result of a decrease in processing costs is greater than the increase in farm prices, showing that consumers receive a greater share of the benefits than do farmers.

Under the scenario of relatively inelastic supply depicted in Figure 4.4(b) the opposite is the case. The decline in the retail price of meat is less than the increase in the farm price, showing that livestock producers receive more of the benefits of lower processing costs than do consumers.

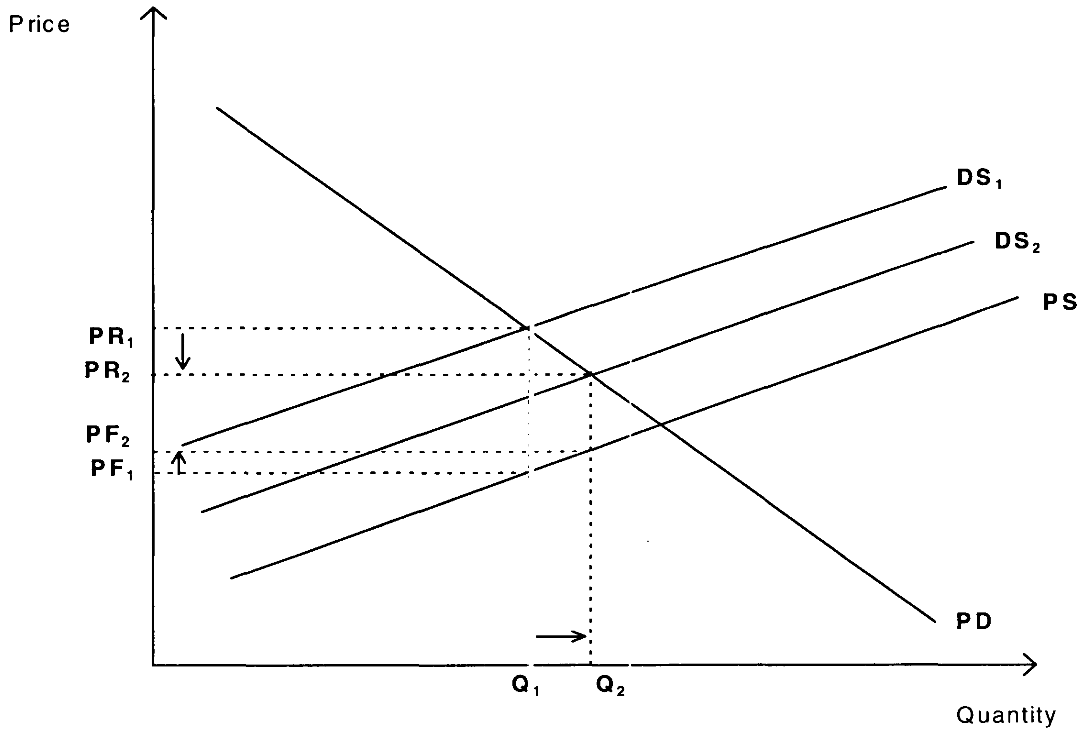
In summary, the more elastic is supply relative to demand, the more consumers will benefit relative to producers from lower processing costs. The more inelastic is supply, the more livestock producers will benefit relative to consumers.

According to Tomek and Robinson, supply is generally considered to be relatively inelastic for many agricultural products (at least in the short-run) and therefore, the incidence of a given change in margins would be greater at the farm level than at the retail level. In the limiting case of perfectly inelastic supply, all of the margin change would fall on the farm price. Time lags in the production process of agricultural products is the major reason why their supply tends to be relatively inelastic. For example, once a crop is planted, a farmer has little scope to change production decisions in response to a fall in the market price of that crop. The implications of lagged adjustment processes are discussed in the next section.

As noted earlier, the nature of the relationship between primary and derived demand and supply will also have an impact on the incidence of a change in margins. Where these curves are parallel (as shown in Figures 4.3 and 4.4), the supply of marketing services (for example, processing) is perfectly elastic, implying that processors do not retain any of the benfefits of reform. However, where these curves diverge, processors are able to appropriate some of the benefits of labour market reform as the supply of their services is not perfectly elastic. This scenario is illustrated in Figure 4.5. The change in retail and farm prices under this scenario is smaller than in the case of parallel primary and derived supply and demand curves.

Figure 4.4 The distribution of lower processing costs under different elasticities of supply

(a) Elastic supply



(b) Inelastic supply

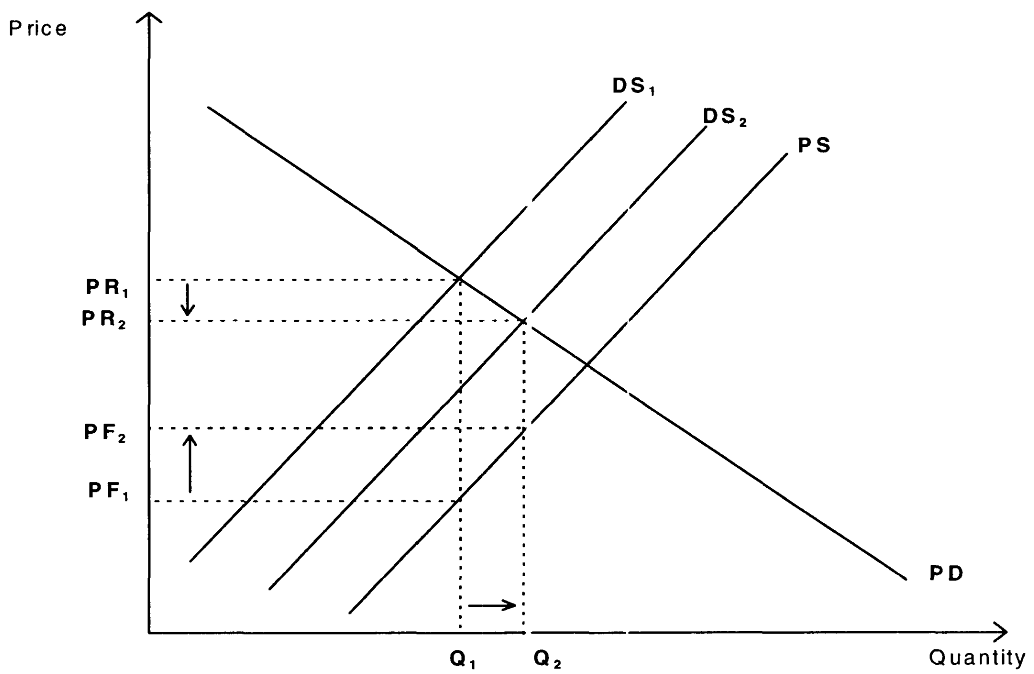
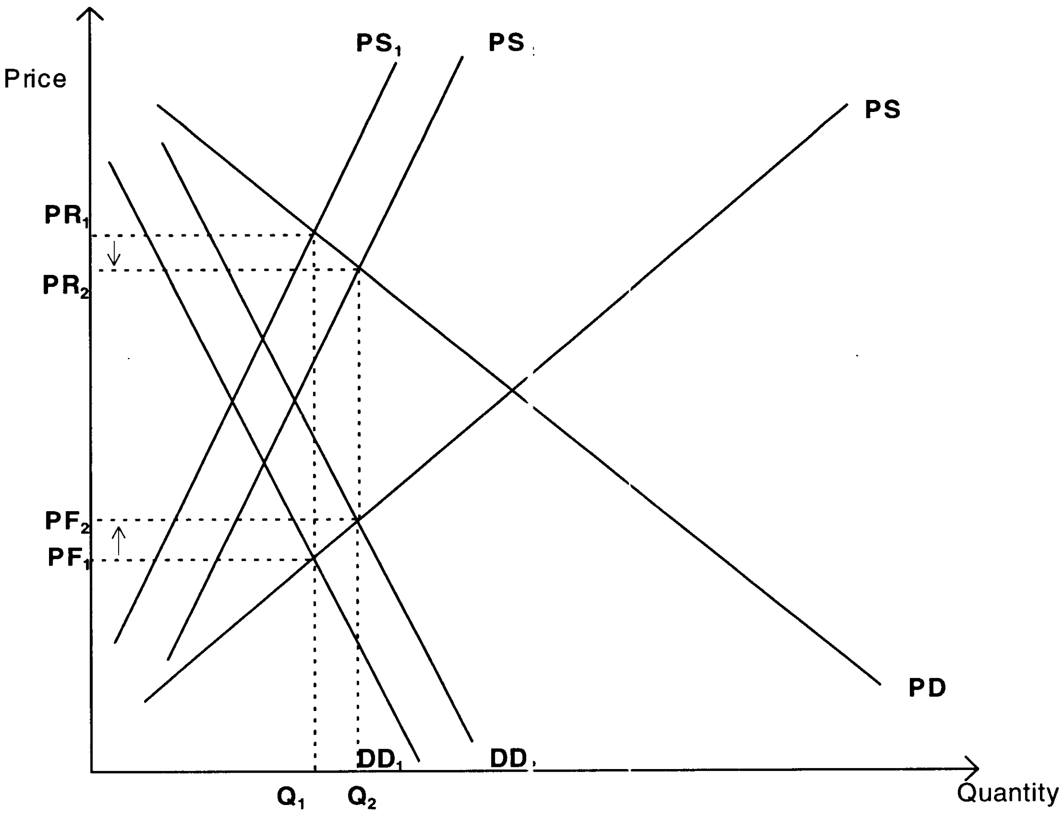


Figure 4.5 The distribution of lower processing costs where the supply of marketing services is not perfectly elastic



4.2.4 Lagged adjustment

The above analysis assumes that markets are perfectly competitive and any changes in margins will be immediately passed on to producers and consumers, depending on their relative responsiveness to price changes. However, markets are rarely perfectly competitive. Information about prices may not be readily available, production lags may exist at the farm level that make responsiveness to price changes slow and meat processors and/or retailers may utilise pricing practices that are inflexible in the short term.

Tomek and Robinson discuss a number of empirical 'price transmission' studies of the relationship between farm, wholesale and retail prices. These studies indicate that lags do exist in price adjustments and that the length of the time lag is related to the amount of processing that occurs. Adjustment lags are shortest for relatively unprocessed commodities such as eggs and fresh fruit and vegetables, but are longest for fats and oils and processed fruit and vegetables. Another reason cited for lagged price adjustments is that retailers do not like to re-mark their prices once goods are on the shelf as this can be costly and disruptive to consumers. Market power held by one segment of the industry is another possible explanation for lagged price adjustments.

In summary, adjustments at the various industry levels to a change in market conditions may take some time to occur. In this situation, the immediate beneficiary of lower processing costs - meat processors - may receive a greater share of the benefits, at least in the short term, until the industry adjusts completely to the changed market conditions. However, the results from the Equilibrium Displacement Model (EDM) simulations represent a 3-5 year time span, and consequently, the issue of lagged adjustment is not likely to be of importance in the results presented in chapter 6.

4.3 Marketing margins in an algebraic framework

This section provides a more formal description of the economic framework, primarily using a model developed by Gardner (1975), with comments on extensions to Gardner's analysis by a number of other authors. These studies illustrate the relationship between the farm and retail levels of the market, and as such, provide an algebraic exposition corresponding to the graphical analysis in the previous section. The EDM, discussed in the next chapter, is based on the algebra of these sorts of models.

4.3.1 Gardner's model

The implications of simultaneous equilibrium in the markets for retail food, farm output and marketing services for the relationship between farm and retail food prices can be represented by a one-product, two-input model of a competitive food marketing industry. Such a model, as developed by Gardner, shows how the farm-retail price spread changes as a result of changes at various levels of the marketing chain, including changes to retail food demand, farm product supply or the supply of marketing services

The model consists of six equations and six endogenous variables. The two factors of production, purchased agricultural commodities *(a)* and other marketing inputs *(b)*, are used to produce a food product *(x)* sold at retail. Gardner's model is outlined below. The production function of the processing/marketing industry (assumed to yield constant returns to scale) is

(4.1) $$x=f(a,b)$$

The retail food demand function is

(4.2) $$x=d(P_x,N)$$

where P_x is the retail price of food and N is an exogenous demand shifter, assumed to be population. For the input market, firms are assumed to want to buy the profit-maximising quantities of b and a, implying that the value of marginal product equals price for both. This is represented by

(4.3) $$P_b=P_xf_b$$

(4.4) $P_a = P_x f_a$

where f_b and f_a are the partial derivatives of x with respect to both b and a. The equations representing the supply of inputs in Gardner's model are

(4.5) $P_b = g(b, T)$

(4.6) $P_a = h(a, W)$

The exogenous shifters of the marketing input and farm product supply are T and W, which represent a tax on marketing inputs and a weather variable respectively. At equilibrium, the value of the endogenous variables, and therefore the farm-retail price spread, are determined.

A change in meat processing costs is equivalent to the shift in the marketing input supply equation (equation 4.5), due to a tax on marketing inputs. Gardner shows that the percentage margin between P_x and P_a increases when P_b rises as a result of a specific tax on marketing inputs. Thus, he found that an exogenous change (tax increase) that decreases the supply of marketing inputs will increase the retail-farm price ratio.

Gardner's analysis highlights the importance of the elasticity of substitution in assessing the impact of a change at any level in the food production/marketing chain. The elasticity of substitution (σ) indicates how a change in the price of one input will affect the demand for the other. This occurs because all prices, in theory, are linked together in an interdependent system and consequently, a change in the price of one good or service induces shifts in demand for others. The direction of this change in demand depends on the direction of change in the price of the related good or service and on whether the related commodity is a substitute or a complement (Tomek and Robinson, 1990).[18] The graphical analysis in Figures 4.3 and 4.4 assumes fixed proportions in food marketing (that is, the elasticity of substitution is zero, $\sigma = 0$). The advantage of Gardner's mathematical model is that it illustrates the more general case where $\sigma \geq 0$. This scenario is illustrated in Figure 4.5 in the previous section.

Gardner explains the role of the elasticity of substitution between a (agricultural commodity) and b (other marketing inputs) and the consequences of it being greater than zero. To do this he uses the example of an increase in the exogenous demand shifter N (population) and assumes that the own price elasticity of supply of a is less than the own price elasticity of supply of b ($e_a < e_b$). This causes the price of the raw farm product to increase relative to marketing inputs, creating an incentive to substitute the latter for the former. The increase in demand for x causes the derived demand for both farm products and marketing inputs to increase. However, when the elasticities of supply of the two inputs are different ($e_a \neq e_b$), their relative prices will change. The extent to which their relative prices change depends on the degree of substitutability between a and b in the food marketing process. The higher the value of σ, the less the relative prices of a and b will change when P_x changes in response to a demand increase.

4.3.2 Extensions

The importance of the elasticity of substitution in determining the distribution of the benefits flowing from a change in any stage of a multi-level agricultural production system was further highlighted by Alston and Scobie (1983). Assessing the distribution of research gains using a general two-factor model, Alston and Scobie show that the distribution of benefits is fundamentally dependent on the elasticity of factor substitution. Their model shows that

[18] Tomek and Robinson note however that, although all prices in an economy are interrelated in theory, some goods/services can be treated as independent.

farmers' absolute gain from a shift of the marketing services supply function decreases as σ increases. They found that, in the case of fixed proportions ($\sigma=0$), when either the farm input supply or the marketing supply function shifts down in parallel, the total benefit and its distribution are the same. When only the supply of marketing services shifts, the benefits to farmers declines rapidly as the elasticity of substitution increases. In contrast to this, when the farm input supply function shifts down, the benefits to farmers increase as the elasticity of substitution increases.

In summary, Alston and Scobie conclude that farmers receive a greater share of the total benefits from farm-level research than from research which induces a similar shift in the supply of marketing services whenever the elasticity of substitution is not zero.

Wohlgenant (1993) undertook a similar analysis, though extending it to include the distribution of gains from promotion. He compared the distribution of benefits derived from promotion (which shift the consumer demand curve) with the distribution of benefits derived from research (which shift the input supply curves). Following Alston and Scobie's approach, he relaxes the assumption of fixed input proportions, removing producer's indifference between spending funds on promotion and research. Wohlgenant shows that a producer-financed program that results in an increase in retail demand will generate returns to producers that are generally smaller than returns generated through shifting the producer supply curve downward by the same amount. Consequently, he concludes that producers would generally prefer activities that reduce production costs by an equal amount compared to marketing cost reductions and promotion activities. This is because returns to producers from equal reductions in marketing (processing and distribution) costs are typically smaller than returns from an equal reduction in processing costs. In line with Alston and Scobie's analysis, Wohlgenant finds the distribution of gains to be crucially dependent on the extent of substitutability between farm and non-farm inputs in producing the final retail product.

Mullen, Alston and Wohlgenant (1989) provided further evidence of the importance of the elasticity of substitution. Their analysis focused on the returns to Australian woolgrowers from equal percentage reductions in the cost of growing wool, top making and textile processing. Using an equilibrium displacement model (EDM) of the world wool top industry, they found that research resources have to be more efficient when employed in off-farm activities for the Australian wool industry to receive benefits similar to those from farm research activities. However, the returns to the industry from these different types of research and development were found to be sensitive to the extent of substitution possibilities between Australian wool and other inputs used by the wool processing and textile industries.

The distribution of benefits from a reduction in processing costs resulting from labour market reform in the meat processing industry can be analysed using this type of analysis. In the case of a change in meat processing costs due to labour market reform, substitution can occur on two levels: between the livestock input and all other inputs in aggregate and between labour and other non-livestock inputs. The former elasticity will determine how much of the benefits from processing sector reform goes to cattle producers and how much goes to the suppliers of the processing inputs. The latter elasticity of substitution determines how much of the share of benefits going to suppliers of processing inputs goes to labour compared to suppliers of other non-livestock inputs (for example, capital, management). In a study of the Australian red meat processing sector, Griffith and Verspay (1987) found no evidence of input substitution. In other words, a complementary rather than a substitution relationship was found to exist between specific inputs used in the meat processing industry. This finding suggests the production technology of the industry is consistent with fixed proportions. However, the question of the degree of substitution between the livestock input and all other inputs in aggregate was not addressed.

Each of the studies discussed above (Gardner, 1975; Alston and Scobie, 1983; Wohlgenant, 1993; Mullen et al., 1989), provide an analysis of how the gains from supply and demand changes at various levels of multistage agricultural production system are distributed throughout the industry. These algebraic studies provide a more formal analysis corresponding to the diagrammatic analysis in section 4.2. These studies also highlight the critical importance of input substitution possibilities in determining the distribution of benefits.

4.4 Summary

This chapter has set out an economic framework for analysing the distribution of benefits flowing from lower meat processing costs due to increased labour productivity. This framework is the basis of the EDM of the cattle and beef industry which is outlined in the next chapter. Chapter 6 reports the results of applying the EDM using the estimates of processing cost reductions from labour market reform in the meat processing industry derived in chapter 3.

Chapter 5 The modelling framework

5.1 Background

The impact on producers, consumers and other groups in the cattle and beef industry of lower processing costs due to labour market reform in the meat processing industry is modelled using an EDM of the cattle and beef industry. This model was developed by Zhao, Mullen and Griffith of the Cooperative Research Centre (CRC) for the Cattle and Beef Industries, University of New England. The explanation of the modelling framework given in this chapter is drawn from Zhao, Mullen and Griffith (1995). In section 5.2, the structure of the EDM model is explained.

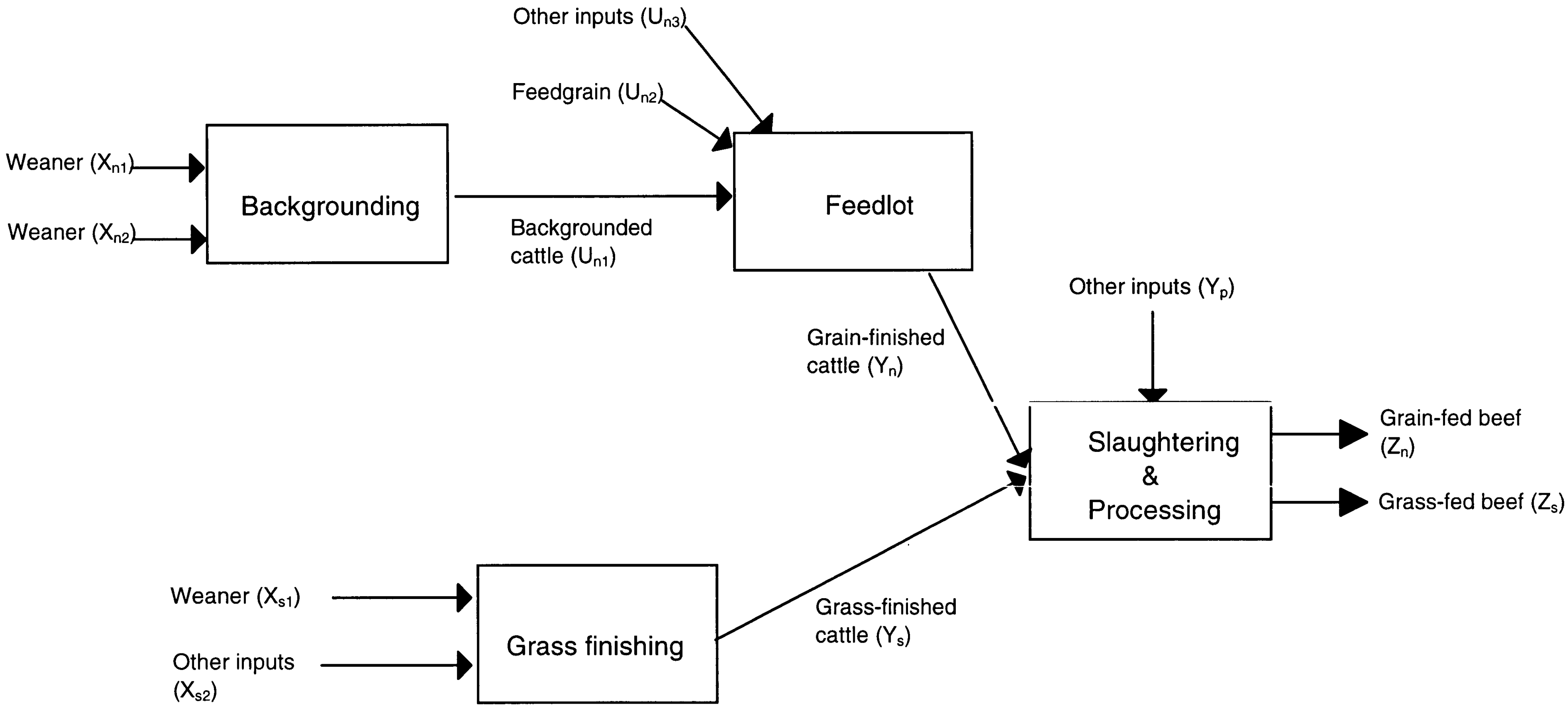
5.2 Explanation of the model

The EDM specifies the relationships between different sectors of the cattle and beef industry using a set of supply and demand relations under equilibrium. The EDM is based on the type of models discussed in the previous chapter. The impact of a number of changes to the system, such as changes induced by research, technological change or promotion, can be simulated by a shift in the relevant exogenous shifters that are part of the model. For the purpose of this research, it is the change in T_{yp}, the shifter of 'other processing inputs' that simulates the disturbance to the system due to labour market reform in the meat processing sector. The structure of the model is discussed in greater detail below.

5.2.1 Model structure

The cattle and beef industry comprises three sectors in the current EDM framework - cattle breeding, cattle finishing and beef processing. The beef marketing sector is not yet developed. In order to take account of the growing importance of grain-fed beef production and the focus of the research programs in the Beef CRC, the finishing sector is further divided into grass finishing and grain finishing. The grain finishing sector is further disaggregated into backgrounding and feedlotting. A diagrammatic illustration of the EDM is given in Figure 5.1.

Figure 5.1 EDM model structure



Source: Zhao, Mullen & Griffith (1995, p.7)

In algebraic terms, the following equations outline the structure of the EDM.

Production functions

Grass finishing:

(5.1) $Y_s = Y_s(X_{s1}, X_{s2})$

where Y_s is the quantity of grass-fed cattle, X_{s1} and X_{s2} are weaner cattle for grass finishing and other inputs respectively.

Grain finishing:

(5.2) $U_{n1} = U_{n1}(X_{n1}, X_{n2})$

(5.3) $Y_n = Y_n(U_{n1}, U_{n2}, U_{n3}$

The grain finishing sector comprises two separate production functions. Equation (5.2) is the production function for the backgrounding sector, where U_{n1} is the quantity of backgrounded feeder cattle, and X_{n1} and X_{n2} represent weaner cattle for backgrounding and other inputs respectively.

The production function for feedlot finishing is given by equation (5.3), where Y_n is the quantity of grain-fed cattle, and U_{n2} and U_{n3} are feedgrain and other inputs.

Beef processing:

(5.4) $G(Z_n, Z_s) = Q(Y_n, Y_s, Y_p)$

The beef processing sector production function is characterised by a two-product and three-input joint function which describes the process of transforming live finished cattle into wholesale beef carcasses. This process includes slaughtering and processing. Z_n and Z_s are the quantities of wholesale grain-fed and grass-fed beef, and Y_p is other processing inputs other than cattle inputs to the processing sector.

Total cost functions:

Grass finishing:

(5.5) $C_{Ys} = Y_s * H_{Ys}(w_{s1}, w_{s2})$

Backgrounding:

(5.6) $C_{Un1} = U_{n1} * H_{Un1}(w_{n1}, w_{n2})$

Feedlot:

(5.7) $C_{Yn} = Y_n * H_{Yn}(v_{n1}, v_{n2}, v_{n3})$

Processing:

(5.8) $C_G = G * H_G(p_n, p_s, p_p)$

The cost function of producing grass finished cattle Y_s, is given by equation (5.5). The unit cost function is $H_{Ys}(w_{s1}, w_{s2})$, and w_{s1} and w_{s2} represent prices of X_{s1} and X_{s2} respectively.

The cost function of producing backgrounded feeder cattle U_{n1} is given by equation (5.6). $H_{Un1}(w_{n1}, w_{n2})$ is the corresponding unit cost function, and w_{n1} and w_{n2} are prices of x_{n1} and x_{n2} respectively.

Similarly, equation (5.7) is the cost function of producing grain finished cattle Y_n. $H_{Yn}(v_{n1}, v_{n2}, v_{n3})$, is the unit cost function, and v_{n1}, v_{n2}, v_{n3}, are the prices of U_{n1}, U_{n2}, U_{n3}, respectively.

Equation (5.8) is the cost function of producing joint wholesale beef G. The production cost per unit of joint beef product G is $H_G(p_n, p_s, p_p)$. The prices of Y_n, Y_s and Y_p, are p_n, p_s and p_p respectively.

Revenue function

(5.9) $R_Q = Q * H_Q (s_n, s_s)$,

Equation (5.9) gives the revenue function subject to a joint input level Q, where $H_Q(s_n, s_s)$ is the unit revenue (or the unit price) function, and, s_n and s_s are the prices of Z_n and Z_s.

Based on the production and cost equations outlined above, a set of supply and demand relations and equilibrium conditions are used to illustrate the interaction between different sectors of the EDM and other related industries. Internal and external shocks to the system are accommodated using a number of exogenous variables. Incorporating these equations and exogenous shifters, the following system of equations describes the Australian cattle and beef industry.

(5.10) $Z_n = Z_n(s_n - \Delta s_n, s_s - \Delta s_s)$ *wholesale grainfed beef demand*

(5.11) $Z_s = Z_s(s_n - \Delta s_n, s_s - \Delta s_s)$ *wholesale grassfed beef demand*

(5.12) $Z_n = h_{Qn}(s_n, s_s) * Q$ *wholesale grainfed beef supply*

(5.13) $Z_s = h_{Qs}(s_n, s_s) * Q$ *wholesale grassfed beef supply*

$(5.14)\ G(Z_n, Z_s) = Q(Y_n, Y_s, Y_p)$ *joint beef production function*

$(5.15)\ H_Q(s_n, s_s) = H_G(p_n, p_s, p_p)$ *joint processing equilibrium condition*

$(5.16)\ Y_n = h_{Gn}(p_n, p_s, p_p) * G$ *grainfed cattle demand*

$(5.17)\ Y_s = h_{Gs}(p_n, p_s, p_p) * G$ *grassfed cattle demand*

$(5.18)\ Y_p = h_{Gp}(p_n, p_s, p_p) *G$ *processing input demand*

$(5.19)\ p_n = H_{Yn}(v_{n0}, v_{n1}, v_{n2})$ *grainfed cattle supply*

$(5.20)\ p_s = H_{Ys}(w_{s1}, w_{s2})$ *grassfed cattle supply*

$(5.21)\ p_p = p_p(Y_p, T_{yp})$ *processing input supply*

$(5.22)\ U_{n1} = Y_n * h_{yn1}(v_{n1}, v_{n2}, v_{n3})$ *backgrounded cattle demand*

$(5.23)\ U_{n2} = Y_n * h_{Yn2}(v_{n1}, v_{n2}, v_{n3})$ *feedgrain demand*

$(5.24)\ U_{n3} = Y_n * h_{Yn3}(v_{n1}, v_{n2}, v_{n3})$ *other feedlot input demand*

$(5.25)\ v_{n1} = H_{Un1}(w_{n1}, w_{n2})$ *backgrounded cattle supply*

$(5.26)\ v_{n2} = v_{n2}(U_{n2}, T_{Un2})$ *feedgrain supply*

$(5.27)\ v_{n3} = v_{n3}(U_{n3}, T_{Un3})$ *other feedlot input supply*

$(5.28)\ X_{s1} = Y_s * h_{Ys1}(w_{s1}, w_{s2})$ *weaner for grass-finishing demand*

(5.29) $X_{s2} = Y_s * h_{Ys2}(w_{s1}, w_{s2})$ *other grass-finishing input demand*

(5.30) $X_{n1} = U_{n1} * h_{Un11}(w_{n1}, w_{n2})$ *weaner for grain-finishing demand*

(5.31) $X_{n2} = U_{n1} * h_{Un12}(w_{n1}, w_{n2})$ *other backgrounding input demand*

(5.32) $w_{n1} = w_{n1}(X_{n1}+X_{s1}, T_{Xn1})$ *weaner for grain-finishing supply*

(5.33) $w_{s1} = w_{s1}(X_{n1}+X_{s1}, T_{Xs1})$ *weaner for grass-finishing supply*

(5.34) $w_{n2} = w_{n3}(X_{n2}, T_{Xn2})$ *other backgrounding input supply*

(5.35) $w_{s2} = w_{s2}(X_{s2}, T_{Xs2})$ *other grass-finishing input supply*

Table 5.1 provides a definition of the symbols used in the equations listed above. A detailed description of these equations and their interrelationships are given in Zhao, Mullen and Griffith (1995).

Table 5.1 Definition of symbols

Z_n, Z_s:	Quantities of wholesale grainfed and grassfed beef
s_n, s_s:	Prices of Z_n and Z_s
N_n, N_s:	Demand shifters for Z_n and Z_s
Q, G	Quantities of aggregated input and output of beef processing sector
Y_n, Y_s, Y_p	Quantities of grain-finished cattle, grass-finished cattle and other processing inputs
p_n, p_s, p_p:	Prices of Y_n, Y_s and Y_p
T_{Yp}	Supply shifter for Y_p
U_{n1},U_{n2},U_{n3}	Quantities of backgrounded feeder cattle, feedgrain, and other inputs to the feedlot sector
v_{n1}, v_{n2}, v_{n3}	Prices of U_{n1}, U_{n2} and U_{n3}
T_{Un2},T_{Un3}	Supply shifters for U_{n2} and U_{n3}
X_{n1}, X_{n2}	Quantities of feeder cattle and other inputs to backgrounding sector
w_{n1}, w_{n2}	Prices of X_{n1} and X_{n2}
T_{Xn1},T_{Xn2}	Supply shifters for X_{n1} and X_{n2}
X_{s1}, X_{s2}	Quantities of feeder cattle and other inputs to grass-finishing sector
w_{s1}, w_{s2}	Prices of X_{s1} and X_{s2}
T_{Xs1},T_{Xs2}	Supply shifters for X_{s1} and X_{s2}
X_1	Quantity of total weaner cattle, X_1=X_{n1}+X_{s1}

Source: Zhao, Mullen and Griffith (1995, p.17)

In order to simulate the EDM, the above set of equations are converted to proportional changes, making the coefficients various types of elasticities. For example, wholesale beef demand and supply (equations 5.10 to 5.13) are converted by differentiation into their elasticity form as follows:

$$(5.36)\ EZ_n = \eta_{(Zn,\,sn)}\,(Es_n - \eta_{(sn,\,Nn)}EN_n) + \eta_{(Zn,\,ss)}\,(Es_s - \eta_{(ss,\,Ns)}EN_s)$$

$$(5.37)\ EZ_s = \eta_{(Zs,\,sn)}(Es_n - \eta_{(sn,\,Nn)}EN_n) + \eta_{(Zs,\,ss)}\,(Es_s - \eta_{(ss,\,Ns)}EN_s)$$

$$(5.38)\ EZ_n - EZ_s = -\tau\,(Es_n - Es_s)$$

The processing input demand and supply equations (5.18 and 5.21) converted into their elasticity forms are:

Input demand for processing sector:

$$(5.39)\ EY_n - EY_s = -(\beta_s\sigma_{(Yn,Ys)} + \beta_n\sigma_{(Yn,Ys)} + \beta_p\sigma_{(Yn,Yp)})Ep_n + (\beta_s\sigma_{(Yn,Ys)} + \beta_n\sigma_{(Yn,Ys)} + \beta_p\sigma_{(Ys,Yp)})\,Ep_s + (\beta_p\sigma_{(Yn,Yp)} - \beta_p\sigma_{(Ys,Yp)})Ep_p$$

$$(5.40)\ EY_s - EY_p = (\beta_n\sigma_{(Yn,Ys)} - \beta_n\sigma_{(Yn,Yp)})\,Ep_n - (\beta_n\sigma_{(Yn,Ys)} + \beta_p\sigma_{(Ys,Yp)} + \beta_s\sigma_{(Ys,Yp)})\,Ep_s + (\beta_p\sigma_{(Ys,Yp)} + \beta_n\sigma_{(Yn,Yp} + \beta_s\sigma_{(Ys,Yp)})\,Ep_p$$

Input supply for processing sector:

$$(5.41)\ Ep_n = \delta_{n1}Ev_{n1} + \delta_{n2}Ev_{n2} + \delta_{n3}Ev_{n3}$$

$$(5.42)\ Ep_s = k_{s1}Ew_{s1} + k_{s2}Ew_{s2}$$

$$(5.43)\ Ep_p = (1 / \varepsilon_{(Yp,\,pp)})EY_p + \varepsilon_{(pp,\,TYp)}E'\Gamma_{Yp}$$

Table 5.2 provides a definition of the symbols used in all of the EDM elasticity-form equations, including the examples given above. It includes demand and supply elasticities, elasticities of substitution and transformation, and cost, revenue and quantity shares.

Table 5.2 Definition of symbols in elasticity-form EDM equations

$\eta_{(i, j)}$	Demand elasticity of variable i with respect to variable j
$\tau_{(Zn, Zs)}$	Elasticity of product transformation of Z_n with respect to Z_s
$\varepsilon_{(i, j)}$	Supply elasticity of variable i with respect to variable j
$\sigma_{(i, j)}$	Elasticity of substitution between variable i and variable j
α_n, α_s	Revenue shares of Z_n and Z_s
β_n, β_s, β_p	Cost shares of Y_n, Y_s and Y_p
δ_{n1}, δ_{n2}, δ_{n3}	Cost shares of U_{n1}, U_{n2} and U_{n3}
k_{n1}, k_{n2}	Cost shares of X_{n1} and X_{n2}
k_{s1}, k_{s2}	Cost shares of X_{s1} and X_{s2}
ρ_n, ρ_s	Quantity shares of grainfed beef and grassfed beef wrt. total beef, ie. $\rho_n = Z_n /(Z_n+Z_s)$ and $\rho_s = Z_s /(Z_n+Z_s)$
λ_{n1}, λ_{s1}	Quantity shares of weaner cattle for grain finishing and grass finishing wrt. total weaner, ie. $\lambda_{n1}= X_{n1}/(X_{n1}+X_{s1})$ and $\lambda_{s1} = X_{s1}/(X_{n1}+X_{s1})$

Source: Zhao, Mullen and Griffith (1995, p.17)

Parameter values of EDM

Information on the market parameters listed in Table 5.2 and equilibrium prices and quantities to derive the various shares are necessary to simulate the model. The parameter values incorporated into the EDM are based on information obtained from published data sources and previous research. In particular, market parameters (demand, supply and input substitution elasticities) are drawn from current econometric estimates, economic theory and the EDM author's judgement. The prices and quantities of beef cattle at different stages of the production chain are calculated over a five year period from 1990-1994 using a price spread method. Data on revenue and cost shares are derived from this price and quantity information. Again, a detailed description of the derivation of the parameters used in the EDM is given in Zhao, Mullen and Griffith (1995).

The market parameters that are used for the base run of the EDM are given in Table 5.3. The definitions of the symbols are given in Table 5.2.

Table 5.3 Parameter values for base run of EDM

$\eta(Z_n, s_n)$	-0.5	$\sigma(U_{n2}, U_{n3})$	0.1
$\eta(Z_n, s_s)$	0.48	$\sigma(X_{n1}, X_{n2})$	0.1
$\eta(Z_s, s_n)$	0.12	$\sigma(X_{s1}, X_{s2})$	0.1
$\eta(Z_s, s_s)$	-0.75	α_n	0.2
$\tau(Z_n, Z_s)$	-0.1	α_s	0.8
$\varepsilon(Y_p, p_p)$	15	β_n	0.13
$\varepsilon(U_{n2}, v_{n2})$	0.8	β_s	0.54
$\varepsilon(U_{n3}, v_{n3})$	15	β_p	0.33
$\varepsilon(X_1, w_{s1})$	1.05	δ_{n1}	0.59
$\varepsilon(X_1, w_{n1})$	0.14	δ_{n2}	0.20
$\varepsilon(X_{s1}, w_{s1})$	1.4	δ_{n3}	0.21
$\varepsilon(X_{n1}, w_{n1})$	1.8	k_{n1}	0.76
$\varepsilon(X_2, w_2)$	0.1	k_{n2}	0.24
$\varepsilon(X_{n2}, w_{n2})$	10	k_{s1}	0.8
$\varepsilon(X_{s2}, w_{s2})$	10	k_{s2}	0.2
$\sigma(Y_n, Y_s)$	5	ρ_n	0.18
$\sigma(Y_n, Y_p)$	0.1	ρ_s	0.82
$\sigma(Y_s, Y_p)$	0.1	λ_{n1}	0.12
$\sigma(U_{n1}, U_{n2})$	0.1	λ_{s1}	0.88
$\sigma(U_{n1}, U_{n3})$	0.1		

Source: Zhao, Mullen and Griffith (1995, p.22)

5.2.2 Changes in economic surplus from labour market reform

As a result of changes in the exogenous shifters of the EDM, a new equilibrium will be reached after all the resulting adjustments to supply and demand have taken place. For the purpose of this research, the exogenous supply shifter T_{yp}, shown in equation (5.21), is of interest as it is the variable that shifts as a result of labour market reform in the meat processing sector. A negative shift in T_{yp} is a downward shift in the supply of processing inputs from the point of view of the price axis. The lower price of 'other processing inputs' encourages demand and, because there is little substitution between livestock and non-livestock inputs, this causes the demand (and therefore price) for livestock to increase. However, due to the greater processing throughput, the supply of carcases at wholesale increases and, consequently, their price decreases.

The impact of this shift in T_{yp} and resulting change to equilibrium on producers, consumers and other groups is measured in terms of changes in the equilibrium prices and quantities of each variable and changes to economic surplus, as described in section 4.2.3, using the normal formulae (Zhao et al., 1995, p. 15-18).

5.3 Summary

The existing EDM of the cattle and beef industry provides a framework for assessing the level of benefits from labour market reform in the meat processing industry and how those benefits are distributed between producers and consumers. The EDM is based on the types of models discussed in the previous chapter. In chapter 6, the results of a simulation of the EDM for cost reductions due to labour market reform are given. The estimates of cost reductions used are based on information obtained from the literature review in chapter 3.

Chapter 6 Results and discussion

6.1 Introduction

Results of the simulation of the EDM model for a reduction in meat processing costs due to labour market reform in the industry are given in this chapter. The estimates of potential cost reductions are derived from the review of the literature on this topic in chapter 3. Section 6.2 provides a brief summary of these estimates. The results of the simulation in terms of price and quantity changes and changes in producer and consumer surplus are given in section 6.3. The implications of the results and some of the limitations of the analysis are discussed in section 6.4.

6.2 Summary of processing cost reduction estimates

As discussed in section 3.5, a number of recent studies have looked at the issue of the potential cost savings available from workplace reform in the meat processing industry. These studies and their results form the basis of the cost reductions modelled using the EDM. In order to base the cost reduction estimates on studies that are broadly comparable, only the results for Australian abattoirs achieving labour cost levels of New Zealand abattoirs are used as the basis for the EDM simulations. Table 6.1 summarises the relevant results.

Table 6.1 Estimates of processing cost reductions due to labour market reform

Study	*Estimated reduction in processing costs (%)*	*Comment*
Industry Commission	8.2	In line with New Zealand cost level.
Booz-Allen & Hamilton	10.2	In line with New Zealand (traditional technology) cost level.
	20.8	In line with New Zealand (hot boning technology) cost level.
CIE	8.6	Adopting AMH new work arrangements.

The cost reduction estimates summarised above refer to all non-livestock *processing costs* in total (not just labour costs). These cost reductions are equivalent to a change in 'Y_p' (other inputs) in the EDM. For the purpose of the EDM simulation, the results in Table 6.1 are indicative of the magnitude of the cost reduction.

Based on the range of results of these studies, a 'best estimate' of 10 per cent is the most appropriate estimate to use for the EDM simulation. It is the most reliable estimate because the Industry Commission study, the Booz-Allen & Hamilton study (traditional technology) and the CIE study give results that are of a broadly similar order of magnitude (8.2, 10.2 and 8.6 per cent respectively). These are both very detailed and comprehensive studies of labour costs in Australian abattoirs compared to labour costs for equivalent abattoirs in New Zealand. Therefore, given the reliability of these estimates, a 10 per cent reduction in direct processing costs is simulated as this is the most likely outcome of workplace reforms in Australian abattoirs.

6.3 Results for EDM simulation of 10 per cent reduction in processing costs

To simulate this change in processing costs, the value of the supply shifter of other processing inputs, T_{yp} in equation 5.21, is changed (ET_{yp} = -0.10 in equation 5.45). This external shock to the industry will result in a new equilibrium being reached. The changes to equilibrium prices and quantities and producer and consumer surplus as a result of this external shock quantify the impact of workplace reforms in the meat processing industry on the producers, consumers and other groups in the cattle and beef industry. The results of this EDM simulation are given below. Table 6.2 provides an explanation of the terms used in the EDM simulation results. The term 'E' refers to a proportional change in the variable, 'Δ' refers to an absolute change in the variable.

Price and quantity changes

A change in the supply shifter 'T_{yp} disturbs the initial equilibrium in the cattle and beef industry and causes a new equilibrium to be reached. Assuming the market parameters stay constant in this process, proportional changes in the endogenous prices and quantities can be calculated using the EDM. The percentage price and quantity changes for a 10 per cent reduction in the costs of supplying 'other processing inputs' are given in Table 6.3.

The decrease in the cost of supplying 'other processing inputs' will have a direct impact on the processing industry initially, and then there will be flow-on effects both to the upstream cattle industry and the downstream wholesale/retail industry. In terms of the diagrammatic analysis in chapter 4, a negative shift in T_{yp} is a downward shift in the supply function of other processing inputs with respect to the price axis. This lower price causes the demand for other processing inputs to increase and, because of a low level of substitution between livestock and non-livestock inputs (elasticities of substitution of 0.1 between both grain and grass-fed beef and other processing inputs), this also increases the demand for cattle as processing inputs. As a result, the price of cattle increases. In terms of the downstream effects, the greater throughput in the meat processing sector causes an increase in the supply of meat products (both grain and grass-fed) at wholesale. This in turn decreases the price for carcases at the wholesale/retail level. In summary, reduced processing costs will reduce the marketing margin, will result in greater output from the processing sector, lower wholesale/retail prices for meat and higher farm prices for livestock.

In quantitative terms, the table 6.3 shows that, as a result of a 10 per cent reduction in the cost of supplying other processing inputs to the meat processing industry, the quantity of beef demanded by consumers increases by 0.56 per cent for grain-fed beef consumers and 1.57 per cent for grass-fed beef consumers. The price of both grain and grass-fed beef declines due to greater processing throughput, with the price of grain-fed beef decreasing most (down 3.71 per cent compared to 2.69 per cent). The greater increase in the demand for grass-fed beef arising from a smaller decrease in its price reflects cross-price effects and the fact that the demand for grass-fed beef is more elastic than the demand for grain-fed beef.

The quantity demanded of other inputs increases by 2.07 per cent because the price of these inputs has decreased. This in turn increases the quantity of grain and grass finished cattle demanded by the processing sector, which increase by 1.11 per cent and 1.01 per cent respectively. As noted above, the degree of substitution between livestock and non-livestock inputs is an important determinant of this result. The price of both grain and grass finished cattle increase by 0.44 per cent and 0.56 per cent respectively as a result of this greater demand for livestock inputs. The increased throughput in processing contributes to this greater demand for all inputs and higher prices upstream.

Table 6.2 Explanation of terms

EZn	Quantity wholesale grain-fed beef	Ews2	Price of other inputs to grass-finishing sector
EZs	Quantity wholesale grass-fed beef	ECS_n ΔCS_n	Change in surplus for consumers of grain-fed beef
Esn	Price of grain-fed beef	ECS_s ΔCS_S	Change in surplus for consumers of grass-fed beef
Ess	Price of grass-fed beef	EPS_{Yp} ΔPS_{Yp}	Change in surplus for suppliers of other inputs into meat processing
EYn	Quantity of grain-finished cattle	EPS_{Un2} ΔPS_{Un2}	Change in surplus for suppliers of feedgrain
EYs	Quantity of grass-finished cattle	EPS_{Un3} ΔPS_{Un3}	Change in surplus for suppliers of other inputs into feedlots
EYp	Quantity of other processing inputs	EPS_{x1} ΔPS_{X1}	Change in surplus for weaner suppliers (grass and grain)
Epn	Price of grain-finished cattle	EPS_{Xn2} ΔPS_{Xn2}	Change in surplus for suppliers of other inputs into backgrounding
Eps	Price of grass-finished cattle	EPS_{Xs2} ΔPS_{Xs2}	Change in surplus for suppliers of other inputs to grass-finishing
Epp	Price of other processing inputs	ECS ΔCS	Change in consumer surplus
EUn1	Quantity of backgrounded feeder cattle	EPS_F ΔPS_F	Change in total livestock producer surplus
EUn2	Quantity of feedgrain	ETS ΔTS	Total change in surplus
EUn3	Quantity of other inputs into feedlot sector	rCN	Grain-fed beef consumers' share of increase in total surplus
Evn1	Price of backgrounded feeder cattle	rCS	Grass-fed beef consumers share of increase in total surplus
Evn2	Price of feedgrain	rC	Total beef consumers share of increase in total surplus
Evn3	Price of other inputs into feedlot sector	rPS_{Yp}	Suppliers of other inputs into meat processing share of increase in total surplus
EXn1	Quantity of feeder cattle to background sector	rPS_{Un2}	Feedgrain suppliers share of increase in total surplus
EXn2	Quantity of other inputs to backgrounding sector	rPS_{Un3}	Other input suppliers to feedlots share of increase in total surplus
Ewn1	Price of feeder cattle input to backgrounding sector	rPS_{X1}	Weaner producers share of increase in total surplus
Ewn2	Price of other inputs into backgrounding sector	rPS_{Xn2}	Other input suppliers to backgrounding share of increase in total surplus
EXs1	Quantity of feeder cattle into grass-finishing sector	rPS_{Xs2}	Other input suppliers to grass-finishing share of increase in total surplus
EXs2	Quantity of other inputs to grass-finishing sector	rPS_F	Total livestock producers share of increase in total surplus
EX1	Combined livestock sellers		

Table 6.3 Percentage price and quantity changes for 10 per cent reduction in costs of supplying 'other processing inputs'

EZn	0.56	EUn3	1.13
EZs	1.57	EVn1	0.54
Esn	-3.71	EVn2	0.54
Ess	-2.69	EVn3	0.08
EYn	1.11	EXn1	1.07
EYs	1.01	EXn2	1.03
EYp	2.07	EWn1	0.67
Epn	0.44	EWn2	0.11
Eps	0.56	EXs1	1.00
Epp	-9.86	EXs2	1.06
EUn1	1.09	EX1	1.01
EUn2	1.09	EWs2	0.11

The price of other processing inputs decreases by 9.86 per cent, which is roughly equivalent to the original decline in the costs of other processing inputs of 10 per cent.[19]

Upstream industries are also affected by the reduction in processing costs. The quantity of backgrounded feeder cattle and feedgrain as inputs into the feedlot sector both increase by 1.09 per cent and the price of both increase by 0.54 per cent. The quantity demanded of other inputs into the feedlot sector increase by 1.13 per cent and the price of other inputs into feedlotting increase by 0.08 per cent.

The quantity of feeder cattle demanded as input into the background sector increase by 1.07 per cent and their price increase by 0.67 per cent. The quantity

[19] The difference is explained by substitution between livestock and non-livestock inputs into processing.

of other inputs into the backgrounding sector increase by 1.03 per cent and their price increase by 0.11 per cent.

The quantity of feeder cattle demanded as input into the grass finishing sector increase by 1.00 per cent and the quantity of other inputs into the grass finishing sector increase by 1.06 per cent. The price of other inputs into the grass finishing sector increase by 0.11 per cent. EX1 is the quantity demanded of weaner cattle, both as inputs to grass finishing and backgrounding. The demand for weaners in total increases by 1.01 per cent.

The diagrammatic analysis of chapter 4 showed that reduced processing costs resulted in lower marketing margins, with consumers of beef paying lower retail prices and livestock producers receiving higher prices for their cattle. The above results quantify these changes. Beef consumers benefit by paying approximately 3 per cent less for meat (3.71 and 2.69 per cent for grain-fed and grass-fed respectively). Livestock producers benefit by receiving about 0.5 per cent more for their cattle (0.44 and 0.56 per cent for grain-fed and grass-fed cattle respectively). Processors also benefit because the elasticity of substitution between processing inputs is less than perfectly elastic. This corresponds to the non-parallel supply and demand curves shown in Figure 4.5. If the elasticity of substitution between inputs was perfectly elastic, processors would not retain any benefits from lower costs, and both producers and consumers would receive a higher level of benefits: consumers would pay even less for meat (a beef price reduction of more than 3 per cent) and producers would receive even more for their cattle (price increase of more than 0.5 per cent).

Changes to producer and consumer surplus

Changes to the economic surplus of each participant in the cattle and beef industry can be calculated from the proportional price and quantity changes discussed above. Table 6.4 shows the percentage and absolute changes in producer and consumer surplus that occur as a result of the 10 per cent reduction in processing costs.

Table 6.4 Percentage and absolute changes in producer and consumer surplus

	Percentage change (%)		*Absolute change ($m)*
ECS_n	1.12	ΔCS_n	19.48
ECS_s	3.17	ΔCS_s	146.59
EPS_{Yp}	4.18	ΔPS_{Yp}	3.98
EPS_{Un2}	2.18	ΔPS_{Ln2}	1.23
EPS_{Un3}	2.28	ΔPS_{Ln3}	0.18
EPS_{x1}	2.03	ΔPS_{X1}	28.73
EPS_{Xn2}	2.27	ΔPS_{Xn2}	0.18
EPS_{Xs2}	2.13	ΔPS_{Xs2}	0.99
ECS	2.61	ΔCS	166.07
EPS_F	2.03	ΔPS_F	29.90
ETS	2.52	ΔTS	201.36

Reforms that reduce processing costs by 10 per cent are estimated to result in an increase in total economic surplus of 2.52 per cent. This is equivalent to $201.36 million annually. Consumers (here defined as purchasers of carcases as well as purchasers of meat) receive the greatest share of this increase in economic surplus, with an increase in total consumer surplus of 2.61 per cent, or $166.07 million. Producer surplus also increases by 2.03 per cent, which is equivalent to $29.9 million. These results are for the medium to long-run, after all adjustments have occurred (3-5 years time).

Breaking down this increase in consumer surplus, it is the consumers of grass-fed beef who receive the greatest benefit, with an increase in their consumer surplus of 3.17 per cent, or $146.59 million. Consumers of grain-fed beef receive an increase in total surplus of 1.12 per cent, or \$19.48 million. The absolute value of the increase in consumer surplus is greater for grass-fed beef consumers because the industry is much bigger than the grain-fed beef industry. The percentage change in consumer surplus for grain-fed beef consumers is less than for grass-fed beef consumers because the demand for grain-fed beef is more price inelastic (the own-price elasticity of demand for grain-fed beef is -0.5, whereas for grass-fed beef it is -0.75. This is because grain-fed beef is more of a luxury good than grass-fed beef). Therefore, a decrease in price will not increase quantity demanded by as much as an equivalent decrease for grass-fed beef, making the percentage increase in consumer surplus less for grain-fed beef consumers than for grass-fed beef consumers.

The economic surplus for suppliers of other processing inputs (EPS_{yp}) increased by 4.18 per cent, or \$3.98 million. This group includes all suppliers of non-livestock inputs, including labour, capital and management. This increase occurs because of a scale effect (the increased throughput in abattoirs causes the demand for processing inputs to increase), and a substitution effect between suppliers of other processing inputs and livestock inputs, because other inputs are now relatively cheaper. This effect is small relative to the scale effect. The proportion of this increase in economic surplus that goes to labour or suppliers of other non-livestock inputs will depend on the elasticities of substitution between them. However, the EDM does not measure this, and so no conclusions can be drawn on the share of this increase in economic surplus that goes to employees.[20]

Suppliers of feedgrain into the feedlot sector receive an increase in producer surplus of 2.18 per cent, or \$1.23 million. Suppliers of other inputs into the feedlot sector receive an increase in surplus of 2.28 per cent, or \$0.18 million.

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[20] However, Griffith and Verspay (1987) found little substitution between suppliers of non-livestock inputs.

Livestock producers also receive an increase in economic surplus as a result of the reduction in processing costs. Suppliers of weaners into both the grass finishing and backgrounding sectors receive an increase in economic surplus of 2.03 per cent, or $28.73 million. This is roughly equivalent to the total increase in surplus for livestock producers (2.03 per cent, or $29.9 million).[21] Suppliers of other inputs into backgrounding have an increase in producer surplus of 2.27 per cent, or $0.18 million. Suppliers of other inputs into the grass finishing sector receive an increase in surplus of 2.13 per cent, or $0.99 million.

Shares of changes in economic surplus

The EDM also calculates the shares of the change in total surplus going to each participant in the cattle and beef industry. These shares are summarised in table 6.5.

Table 6.5 Shares of changes in total surplus (per cent)

rCN	9.67	rPS_{Un3}	0.09
rCS	72.8	rPS_{X1}	14.27
rC	82.47	rPS_{Xn2}	0.09
rPS_{Yp}	1.98	rPS_{Xs2}	0.49
rPS_{Un2}	0.61	rPS_{F}	14.85

Consumers of beef benefit the most from reforms in the meat processing industry that reduce production costs, capturing 82.47 per cent of the resulting increase in total surplus. Of this, consumers of grass-fed beef benefit most, receiving 72.8

[21] The $29.9 million that is the total livestock producer surplus is the sum of the economic surplus of combined livestock sellers, suppliers of other inputs into backgrounding and suppliers of other inputs into grass-finishing. These other non-livestock suppliers are included in the total surplus to livestock producers because farmers typically supply other inputs (eg. labour and capital), as well as livestock.

per cent of the increase in total consumer surplus, while consumers of grain-fed beef receive 9.67 per cent of the change in surplus.

Farmers receive 14.85 per cent of the total increase in economic surplus. This figure includes suppliers of weaners to both the backgrounding and grass finishing sectors (14.27 per cent), suppliers of other inputs into backgrounding sector (0.09 per cent) and suppliers of other inputs into the grass finishing sector (0.49 per cent).

The remainder of the increase in economic surplus goes to suppliers of other inputs into meat processing, suppliers of feedgrain into feedlotting and suppliers of other inputs into feedlotting, who receive 1.98 per cent, 0.61 per cent and 0.09 per cent of the increase in surplus respectively.

The economic analysis in chapter 4 showed that consumers benefited most from a change in marketing margins when demand is relatively inelastic and when supply is relatively elastic. The results from the EDM simulation show consumers receiving the bulk of the benefits (nearly 83 per cent) of lower processing costs arising from workplace reform in the processing sector. Livestock producers receive a much smaller proportion of the benefits of reform, receiving nearly 15 per cent. These quantitative results are therefore consistent with a situation where demand is relatively inelastic compared to supply. The is because the analysis here is a medium to long-run analysis, with the EDM results depicting outcomes expected to occur in 3-5 years. Therefore, over this period of time producers are able to adjust their supply response to changing price signals.[22] For example, faced with increased demand for livestock by the processing sector, in the medium to long-run, farmers are able to divert more of their resources (land, labour, capital) to livestock production and away from

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[22] The market parameters incorporated in the EDM for the own-price elasticity of supply of weaners are relatively elastic, with $\varepsilon(X_{s1}, w_{s1}) = 1.4$ and $\varepsilon(X_{n1}, w_{n1}) = 1.8$.

other uses. In the short-run, supply responses are less elastic as there are time lags in agricultural production processes which reduce the flexibility of resource use.

Tomek and Robinson note that the demand for most agricultural commodities is price inelastic - certainly in the short-run but often in the long-run as well. In demand theory, the long-run is defined as the time required for a complete quantity adjustment to occur in response to a once-and-for-all price change. This period will vary for different commodities. The quantity demanded of a product at a given price is likely to change gradually over time for a number of reasons including imperfect knowledge, uncertainty about future price changes, technological and institutional barriers to change and rigidities in consumers habits (Tomek and Robinson, 1990).

Meat processors also receive some benefits from lower processing costs. Processors benefit because the elasticity of supply of processing inputs is less than perfectly elastic ($\varepsilon(Y_p, p_p)$=15) This implies that processors retain some of the benefits of a decrease in processing costs, and therefore not all of the benefits of the cost reduction are passed on to consumers or producers. This situation is equivalent to having non-parallel supply and demand curves depicted in Figure 4.5.

Results for a range of cost reduction estimates

The results reported in this chapter are for a reduction in non-livestock processing costs of 10 per cent. While this figure represents a best estimate of the impact of labour market reform in the meat processing industry on processing costs based on the findings of a number of studies, it may not in fact be fully achievable for a number of reasons (these are discussed in section 6.4).

Given the potential uncertainty associated with achieving this cost saving, results from EDM simulations using upper and lower cost saving estimates are also reported. EDM model runs are also done using a 5 per cent and a 20 per cent reduction in the cost of other processing inputs as an external shock. A 5 per cent reduction in processing cost represents a conservative scenario which may either indicate slow progress of workplace reform or 'patchy' reform across the industry (for example, half of the firms in the industry implement reforms resulting in a 10 per cent cost reduction and the other half do not).

The scenario representing a 20 per cent reduction in processing costs is probably optimistic, and the results are likely to reflect an outer bound of the potential benefits of workplace reform. The basis for this figure is the Booz-Allen and Hamilton study which concluded that if Australian abattoirs achieved the labour productivity levels of a New Zealand abattoir that used hot boning technology, processing costs would be reduced by 20.8 per cent. Although the comparison between an Australian abattoir and a traditional New Zealand abattoir (giving rise to the 10 per cent estimate) is more meaningful given the similar technology, it is instructive to also look at the potential benefits to the Australian cattle and beef industry of achieving 'best practice' New Zealand productivity.[23]

To briefly summarise these other simulation results, under a scenario of a 5 per cent reduction in the cost of other processing inputs, there is an increase in total economic surplus of 1.26 per cent, or $100.3 million dollars. Consumers' economic surplus increases by 1.3 per cent, or $82.74 million, and livestock producers' economic surplus increases by 1.01 per cent, which is equivalent to $14.91 million. Under a 20 per cent cost reduction scenario, total economic surplus increases by 5.08 per cent, which is eual to $405.52 million annually.

[23] This is particularly so as the operation of the tally system in meat industry awards tends to act as a disincentive to investment and technological improvement because, under existing arrangements, the main benefits of any productivity improvements are captured by labour (Industry Commission, 1994).

Consumers benefit by an increase in surplus of 5.27 per cent, or $334.54 million, and livestock producers receive an increase in producer surplus of 4.09 per cent, or $60.10 million. The shares of the increase in economic surplus accruing to each of these groups is similar for each of the scenarios examined.

The detailed results of the EDM simulations for these upper and lower estimates of potential cost savings from workplace reform are reported in Appendix A.

6.4 Implications and limitations of results

6.4.1 Implications

Chapter 1 states that one of the hypotheses to be tested in this dissertation is that

- industry participants, including livestock producers and beef consumers, will benefit from reforms that reduce processing costs.

The results presented in this chapter, although not subject to formal statistical tests, show this hypothesis cannot be rejected. All industry participants, including livestock producers, beef consumers, meat processors and the feedgrain industry, benefit from the hypothesised reduction in processing costs.

In summary, as a result of a 10 per cent reduction in processing costs, there is an increase in total economic surplus of 2.52 per cent, which is equivalent to $201.36 million annually. Of this amount, consumers receive by far the greatest share, capturing 82.47 per cent of this increase in surplus. Livestock producers receive 14.85 per cent of this increase in surplus which, although much smaller than the benefits flowing to consumers, is still significant. Suppliers of other inputs into processing (which includes labour, capital, management and any other non-livestock factors of production) receive 1.98 per cent of this increase in total surplus, while the feedgrain industry receives 0.61 per cent and suppliers of other inputs into feedlotting receive 0.09 per cent of the increase in total surplus.

It is apparent from these results that it is consumers of beef who receive the greatest share of the benefits of labour market reform in the meat processing industry. Consumers face a price decrease of approximately 3 per cent, which is equivalent to an annual increase in consumer surplus of $166.07 million. Livestock producers receive a price increase of approximately 0.5 per cent, which is equivalent to an annual increase in producer surplus of $29.90 million. In terms of the economic framework discussed in chapter 4, this outcome is consistent with a demand curve that is relatively inelastic and a supply curve that is relatively elastic. The results also show processors benefiting from the cost reduction, although the majority of benefits are passed both upstream and downstream. This reflects the fact that the elasticity of supply of processing inputs is not perfectly elastic.

The discussion in chapter 3 of studies examining labour costs in the meat processing industry indicated that there was quite significant scope for improvements in labour productivity in the industry which would in turn contribute to lower processing costs. The results of the EDM simulation presented here show that, to the extent that these labour market reforms are implemented, all participants in the meat processing industry will benefit. Undertaking these reforms therefore results in an increase in economic welfare, mostly for beef consumers, but also for livestock producers and other industry participants.

In terms of the previous studies, the IC (1994) estimated that a productivity improvement of the order of $83 million could be expected from a total non-livestock processing cost saving to abattoirs of 8.2 per cent. The CIE study estimated that for a 19 per cent industry-wide reduction in labour costs, farm cattle output would rise by 0.93 per cent and the price of cattle would rise by 3.2

per cent. Aggregate beef production would increase by 52 000 tonnes annually, and the gross value of beef industry production would increase by $404 million over 10 years, which is equivalent to approximately $40 million per year.

In this study it is estimated that the quantity of feeder cattle demanded would increase by 1.07 per cent and their price would rise by 0.67 per cent, while aggregate beef production would rise some 25 000 tonnes. Given the relative size of the hypothesised cost reductions, these results are broadly consistent. Further, the current estimate of the change in producer surplus of approximately $30 million annually is broadly in line with the CIE estimate of a change in industry revenue of about $40 million annually. However, the EDM results are preferred because they are more disaggregated and they take explicit account of all sectors, showing the impact on all industry participants, including livestock producers, the feedlot industry, feedgrain producers and beef consumers. Moreover, the results are presented in an explicit economic framework which shows the welfare effects of reduced processing costs on all industry participants in terms of changes to producer and consumer surplus.

The benefits flowing from labour market reforms in the cattle and beef industry could also apply to sheepmeat and pig processing. Many abattoirs are joint product plants, producing more than one variety of meat. Consequently, although the actual benefits to the pigmeat and sheepmeat industries are not calculated here, these industries and the consumers of these products are also likely to benefit from labour market reforms in the processing industry.

6.4.2 Limitations of the analysis

It is important to take account of the limitations of the analysis when interpreting the results. These limitations are likely to arise from two main sources. Firstly, there may be limits on the ability to achieve the cost reductions outlined. This would make it unlikely that the full benefits reported here from a 10 per cent reduction in processing costs would be achieved. Secondly, the assumptions underlying the EDM also need to be taken into account when interpreting the results.

Ability to achieve potential cost savings

The estimates of cost savings flowing from labour market reform used as the basis for the EDM simulation represent *potential* savings. However, in reality there are likely to be costs to implementing workplace reform that offset the benefits to some extent. For example, there may be costs associated with negotiating enterprise agreements as well as costs arising from the transition to new working arrangements. Although these costs of implementing workplace reform are not quantified here, it is important to be aware of their existence and the fact that these costs will offset the benefits of reform reported in this chapter.

The cost savings available and the resulting economic welfare improvements reported here may also be overstated because, in reality, these changes are not likely to occur in isolation. Reform to work practices and labour market arrangements are unlikely to be the only changes affecting the industry at any particular time. Other changes, such as technological changes or promotion of meat products, will also have an impact on the meat processing industry. The total benefits of all of these changes will not be the sum of the benefits of individual changes because of substitution effects.

Underlying assumptions of the EDM

The underlying assumptions of the EDM are also important considerations. In particular, there are key assumptions made relating to the parameter values in the model and the functional form of the equations making up the EDM. Although these assumptions are based on empirical evidence and economic theory, they may still be subject to some uncertainty and results need to be interpreted with these limitations and qualifications in mind.

The EDM consists of a set of linear equations. This system will give exact results as long as the actual relationship between any two variables is linear. However, when the actual relationship between two variables is non-linear the EDM approach will give only approximately correct results. The extent of the error arising from this specification of functional form will depend on how non-linear are the true relationships and the extent of the proportionate changes in the variables being examined (Hill and Piggott, 1995). Zhao, Mullen and Griffith (1996) found that, when a parallel shift is assumed and the exogenous shifts are small, errors in both the price and quantity changes and the economic surplus changes are small, regardless of the functional form of the true supply and demand curves. The errors in economic surplus changes are greater when a proportional shift is assumed.

It is also important to emphasise that these results are dependent on the particular parameter values incorporated in the model and that these values may be uncertain. These market parameters include the demand, supply and input substitution elasticities and, as noted in the previous chapter, they are chosen from existing econometric estimates, economic theory and the model authors' judgement. It is possible that the elasticities may be underestimated or overestimated. In drawing conclusions from these results it is therefore important to bear in mind the sensitivity of the results to the parameter values.

Elasticity values may be uncertain for a number of reasons. For example, adequate data may not be available to calculate particular elasticities or it may be difficult to isolate the particular relationship of interest from other factors. Also, where different estimates have been obtained from different studies, subjective judgements have to be made. As discussed above, elasticities can also vary over time and so results from the EDM simulation need to be interpreted within the context of the timeframe depicted by the model parameters.

Another consideration is that elasticities are usually calculated for a particular point on a demand or supply curve and that they are likely to vary at different points along the curve. Therefore elasticity values calculated for one point may not hold for other price and quantity ranges.

The results are also sensitive to assumptions made about the elasticity of substitution between inputs into meat processing. These elasticity values determine the extent to which benefits are passed back to farmers or to suppliers of other processing inputs. The parameter values incorporated in the EDM show a low level of substitution between livestock and non-livestock inputs ($\sigma(Y_n, Y_p)$ = 0.1 and $\sigma(Y_s, Y_p)$ = 0.1). This means that as the demand for other processing inputs increases due to the fact that they are relatively cheaper, the demand for slaughter cattle also increases. However, past studies have shown that the elasticity of substitution is a highly sensitive parameter (Zhao et al., 1995). If there was greater substitution between suppliers of other inputs and suppliers of livestock inputs, suppliers of other inputs would benefit more from a reduction in their cost of supply as they become relatively cheaper and are therefore substituted to a certain degree for livestock in the production process. This would mean that livestock producers would benefit less from a reduction in processing costs under an assumption of higher substitution elasticities than under the current assumption of low substitution between livestock and non-livestock inputs. Changing this parameter value would therefore alter the distribution of benefits from reform.

The parameter values incorporated in the EDM are also less certain for higher percentage cost changes. The usual approach to analysing the impact of exogenous changes is to examine one per cent shifts of exogenous variables along the price direction (Zhao et al., 1995). However, the changes examined here are much larger. For these higher percentage cost changes (particularly the 20 per cent change) the elasticity values in the model are less certain.

6.5 Summary

This chapter discusses the results of the EDM simulation of a 10 per cent reduction in the cost of non-livestock processing inputs flowing from labour market reform in the processing industry. The results show that all industry participants benefit from lower costs, with consumers receiving the greatest share of the benefits. Livestock producers also receive a significant, though much smaller share of the increase in total economic surplus resulting from lower processing costs. The results of previous studies of this issue are more aggregated and have tended to focus on the benefits to abattoirs only of a reduction in processing costs. There are certain limitation to the analysis arising from the assumption underlying the EDM and the achievability of the estimated cost savings that need to be taken into account when interpreting the results. However, given these qualifications, the analysis indicates that there are considerable economic benefits available to the cattle and beef industry and to beef consumers from reforming work practices in the processing industry.

Chapter 7 Summary and conclusions

7.1 Summary

The level of production costs in the meat processing industry, especially labour costs, is an issue that has been of some concern to the cattle and beef industry in Australia. In particular, aspects of industrial relations within the industry and employment conditions embedded in industry awards have frequently been cited as having contributed to relatively low levels of labour productivity, which in turn has increased industry production costs. Relatively high labour costs will adversely affect the profitability of abattoirs, the returns to livestock producers and the prices for beef paid by consumers.

Given this background, this dissertation examines two specific hypotheses. These are that:

- there is scope for labour market reform in the meat processing industry to achieve improvements in labour productivity and therefore reduce production costs; and

- industry participants, including livestock producers and beef consumers, will benefit from reforms that reduce processing costs.

The industrial relations framework in Australia has traditionally been highly centralised. Features of the system have included centralised wage fixing, compulsory arbitration and complex award structures. There has been a move towards a more decentralised industrial relations system in recent years which is increasingly enterprise rather than industry-oriented. Enterprise bargaining is a key feature of this new industrial relations landscape that is expected to lead to increased productivity in workplaces and deliver benefits to both employers and employees. This is primarily achieved through greater flexibility in work practices.

The meat processing industry however has lagged other industries in adopting more flexible work practices. Perhaps the most significant factor inhibiting labour productivity improvements is the number of awards that apply to the industry, their rigidity and complexity and the tally payment system that operates under these awards. This system imposes constraints on productivity, as well as distorting production and investment decisions. Other problems include under-utilisation of industry capacity, a high level of industrial disputation and a situation where processing firms achieve low and volatile financial margins.

A number of studies in recent years have examined these labour market issues in the meat processing industry. Each of these studies found considerable potential for cost savings if Australian abattoirs implement workplace reforms that enhance labour productivity. Some of these studies have made comparisons of labour productivity and costs in Australian abattoirs with New Zealand abattoirs. These studies found that the ability to negotiate work conditions and improve labour productivity by adopting 'best practice' employment levels can deliver considerable cost savings to the industry. Based on these studies, a best estimate of potential processing cost savings of approximately 10 per cent is obtained.

Lower processing costs will change the supply and demand conditions in upstream and downstream industries. The effect of this change was shown by examining changes in marketing margins. The incidence of a change in margins depends on the respective elasticities of supply and demand at the different market levels. This economic framework was illustrated in chapter 4 using both diagrammatic and algebraic analysis.

Changes in industry arrangements or conditions, such as the effects of productivity gains induced by labour market reform, can be modelled using this framework. In this study, an equilibrium displacement model (EDM) was used to quantify the changes in economic surplus resulting from lower processing costs. The EDM specifies the relationships between different sectors of the cattle and beef industry using a set of supply and demand equations under equilibrium. It allows examination of the impact of a change in any level of cattle and beef industry.

The results of the analysis show that all industry participants benefit from lower processing costs, with consumers receiving the greatest share of the benefits (82.5 per cent). Livestock producers receive 14.9 per cent of the increase in economic surplus resulting from the change. Suppliers of other inputs into processing (which includes labour, capital, management and any other non-livestock factors of production) receive nearly 2 per cent of the increase in surplus. The feedgrain industry receives 0.6 per cent and suppliers of other inputs into feedlotting receive 0.09 per cent.

These results show that consumers receive a price decrease of approximately 3 per cent, which is equivalent to an increase in consumer surplus of $166.07 million. Livestock producers receive a price for cattle that is approximately 0.5 per cent higher, which is equivalent to an increase in producer surplus of $29.9 million.

7.2 Conclusions

This research indicates that both of the hypotheses examined are true. Examination of labour market issues in the meat processing industry shows that there is considerable scope to achieve improvements in labour productivity through implementing workplace reforms, thereby reducing processing costs.

Economic theory suggests that, depending on assumptions about elasticities of supply and demand, a reduction in processing costs will improve the returns to industry participants, including meat processors and livestock producers, as well as reducing the wholesale/retail price of beef. Labour market reform that reduces processing costs results in an increase in economic welfare, measured in terms of changes to economic surplus, for all industry participants, including consumers.

There is considerable scope for reform to labour market arrangements in the meat processing industry, in particular, reforms to aspects of awards, which would result in improvements in labour productivity. The industry has been relatively slow to implement reforms to traditional work practices, including changes to awards and greater reliance on enterprise bargaining, that are likely to generate significant improvements in productivity. The analysis undertaken in this research shows that if such reforms were implemented in the meat processing industry, all participants in the industry, would benefit in terms of enhanced economic welfare.

7.3 Areas for future study

The limitations of this study were mentioned in chapter 6. These limitations relate to the ability to achieve the potential cost savings and to the underlying assumptions of the EDM. These lead to some avenues for further research.

As noted in the previous chapter, the cost savings from labour market reform used as the basis for the EDM simulation represent potential savings, and do not take into account the costs of implementing workplace reform. These will include the costs associated with negotiating enterprise agreements and costs arising from the transition to new working arrangements. Further study to quantify these costs of reform will increase the accuracy of the results presented here as they can be balanced against the estimated benefits of reform.

The EDM involves specification of a set of market parameter values describing the relationships between variables. These parameter values are based on empirical evidence, economic theory and the EDM authors' judgement. However, they are still subject to some uncertainty and may be under or overestimated in some cases. Further research, including sensitivity analysis, to improve the accuracy of these parameter values would improve the accuracy of the EDM results.

Appendix A EDM results for a range of cost reduction estimates

A.1 Results for 5 per cent processing cost reduction

Table A1.1 Percentage price and quantity changes for 5 per cent reduction in ET_{Yp}

EZn	0.28	EUn3	0.57
EZs	0.79	Evn1	0.27
Esn	-1.85	Evn2	0.27
Ess	-1.35	Evn3	0.04
EYn	0.55	EXn1	0.54
EYs	0.51	EXn2	0.56
EYp	1.03	Ewn1	0.34
Epn	0.22	Ewn2	0.06
Eps	0.28	EXs1	0.50
Epp	-4.93	EXs2	0.53
EUn1	0.54	EX1	0.50
EUn2	0.54	Ews2	0.05

Table A1.2 Percentage and absolute changes in producer and consumer surplus for 5 per cent change in ET_{yp}

%		$m	
ECS_n	0.56	ΔCS_n	9.73
ECS_s	1.58	ΔCS_s	73.01
EPS_{Yp}	2.08	ΔPS_{Yp}	1.98
EPS_{Un2}	1.09	ΔPS_{Un2}	0.61
EPS_{Un3}	1.13	ΔPS_{Un3}	0.09
EPS_{x1}	1.01	ΔPS_{X1}	14.33
EPS_{Xn2}	1.13	ΔPS_{Xn2}	0.09
EPS_{Xs2}	1.06	ΔPS_{Xs2}	0.50
ECS	1.30	ΔCS	82.74
EPS_F	1.01	ΔPS_F	14.91
ETS	1.26	ΔTS	100.33

Table A1.3 Shares of changes in total surplus for 5 per cent change in ET_{yp}

rCN	9.69	rPS_{Un3}	0.09
rCS	72.77	rPS_{X1}	14.28
rC	82.46	rPS_{Xn2}	0.09
rPS_{Yp}	1.99	rPS_{Xs2}	0.49
rPS_{Un2}	0.61	rPS_F	14.86

A.2 Results for 20 per cent processing cost reduction

Table A2.1 Price and quantity changes for 20 per cent change in ET_{yp}

EZn	1.12	EUn3	2.26
EZs	3.15	Evn1	1.08
Esn	-7.41	Evn2	1.09
Ess	-5.38	Evn3	0.15
EYn	2.19	EXn1	2.14
EYs	2.02	EXn2	2.26
EYp	4.14	Ewn1	1.35
Epn	0.88	Ewn2	0.23
Eps	1.12	EXs1	2.00
Epp	-19.72	EXs2	2.12
EUn1	2.17	EX1	2.02
EUn2	2.17	Ews2	0.21

Table A2.2 Percentage and absolute changes in producer and consumer surplus for 20 per cent change in ET_{yp}

%		$m	
ECS_n	2.26	ΔCS_n	39.07
ECS_s	6.40	ΔCS_s	295.47
EPS_{Yp}	8.44	ΔPS_{Yp}	8.05
EPS_{Un2}	4.39	ΔPS_{Un2}	2.47
EPS_{Un3}	4.58	ΔPS_{Un3}	0.36
EPS_{x1}	4.08	ΔPS_{X1}	57.74
EPS_{Xn2}	4.56	ΔPS_{Xn2}	0.36
EPS_{Xs2}	4.28	ΔPS_{Xs2}	2.00
ECS	5.27	ΔCS	334.54
EPS_F	4.09	ΔPS_F	60.10
ETS	5.08	ΔTS	405.52

Table A2.3 Shares of changes in total surplus for 20 per cent change in ET_{yp}

rCN	9.63	rPS_{Un3}	0.09
rCS	72.86	rPS_{X1}	14.24
rC	82.50	rPS_{Xn2}	0.09
rPS_{Yp}	1.98	rPS_{Xs2}	0.49
rPS_{Un2}	0.61	rPS_F	14.82

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