Chapter 3

3.0 Introduction

Estimating the direct benefits and costs of municipal saleyards involves treating such facilities as private competitive firms. In the absence of market failure this would suffice in identifying the levels of output which generate productive and allocative efficiency. Moreover, this methodology would be sufficient to fulfil one of the major aims of this research; namely, an identification of the minimum efficient scale [MES] of saleyards and the revenue implications of their current management. However, the nature of municipal government necessitates an assessment of indirect costs and benefits. Many publicly owned and operated amenities must consider a broader range of benefits and costs to reflect the broader constituency of government and the role of government in addressing market failure. In chapter one we identified three major indirect costs and benefits. While only one of these factors can be strictly regarded as an externality, inclusion of the other betterments and imposts has important policy implications. This chapter concentrates on the appropriate techniques for estimating these indirect effects and discusses their inclusion within the CBA framework.

The chapter itself comprises three main parts reflecting the different indirect costs and benefits identified in earlier discussion. Section one discusses the estimation of the multiplier impacts of saleyard activity. Care is taken in this section to identify precisely which multiplier impacts can justifiably be included within the CBA framework. Secondly, a technique for estimating the value of livestock market information gained through attendance at saleyard venues is developed. Part three of the chapter discusses techniques for estimating the loss of environmental amenity often attributed to livestock saleyards and discusses the relevance of these issues in the current context. The chapter ends with some brief concluding remarks.

3.1 Multiplier Effects

A multiplier derives from the interdependence between economic agents. It is the concept that an initial change in spending and employment produces further rounds of spending and employment. Similarly, the accelerator principle implies that the actions of one group of economic agents, namely those demanding final goods, triggers reaction by another group, those demanding investment goods. In the current context multiplier, rather than accelerator effects, require further investigation. More specifically, we argue that the spending and income generated by the saleyard facility produces subsequent rounds of expenditure and income via the saleyard facilities' linkages with other economic agents within the regional economy. Amongst other issues, it is the magnitude of this expenditure which must be quantified to provide a comprehensive assessment of the role of municipal saleyards. Moreover, the historic use of the 'multiplier effect' argument to sustain seemingly unprofitable saleyards suggests closer investigation is warranted.

3.1.1 Estimating Multiplier Effects

There are at least three questions which should be answered in relation to the multiplier or expenditure effects created by saleyards. Firstly, should multipliers be included at all in an assessment of the benefits of municipal saleyards? Secondly, which rounds of expenditure and employment are appropriate for inclusion within the CBA framework? Thirdly, what is the appropriate technique for assessing those multiplier effects which can legitimately be included within the CBA framework? Addressing the latter of these questions provides valuable insights into those issues which are relevant in the current context. While there continues to be refinements to the measurement of multiplier effects, [see, for example, Black 1996] the most commonly applied methods for measuring multiplier effects are input-output analysis, the economic base multiplier method and the Keynesian multiplier model (Glasson, Der Wee and Barrett 1988, p. 249). A review of the most commonly applied techniques is presented as a vehicle for discerning the specific relevance of multipliers to this study.

Input-Output Analysis

Input-output analysis derives largely from the work of Leontief in the 1940's using matrices to detail the linkages between various industries within an economy (Arya and Lardner 1989, p. 360). More recently input-output analysis has been given greater currency with the inclusion of input-output tables in the national accounts and the recognition of input-output techniques as a useful method of social accounting (Jensen and West 1986, p. 3). Input-output analysis focuses on the construction of a transaction table which shows relationships between demand for the various sectors' outputs and the derived demand for inputs. Survey data are generally used to compile such tables though a variety of techniques are available to adapt existing transaction tables to specific regional data. The level of aggregation within the transaction table varies with the usual tradeoffs between the availability and management of raw data and the capacity for detailed analysis. The transaction table typically comprises four quadrants, namely, the intermediate quadrant, final demand quadrant, primary inputs quadrant and the primary input to final demand quadrant.

The intermediate quadrant is particularly useful in highlighting the interdependence between sectors within the economy. Moreover, a matrix of coefficients is compiled from this quadrant which converts the financial dimensions of the economy into information which details the direct effects of a change in final demand for any of the sectors specified in this quadrant. This 'A' matrix can be further manipulated to produce estimates of the subsequent indirect effects of a change in final demand. An iterative method or matrix inversion is commonly employed to obtain estimates of the production induced effects of an increase in final demand for output (Jensen and West 1986, pp. 49-50). When compiling regional input-output tables it is common to include the household sector within the coefficient matrix. Thus, it is possible to derive a general solution matrix which enumerates the direct, indirect and consumption induced effects of a change in final demand for any sectors' output.

It is a relatively simply procedure to then produce a series of output multipliers for these sectors which can be disaggregated into their direct, production induced and consumption induced components. Since there is an element of double counting it is often preferable to use value added multipliers rather than output multipliers. Such multipliers focus on the value added at each stage of production and are analogous to the GDP multiplier (Business Connect 1993, p. 20). Employment multipliers are also commonly derived from input-output analysis for their policy significance. These are obtained by multiplying the appropriate inverse matrix by some employment coefficient. Generally, such coefficients are expressed in terms of the number of employees per thousand dollars of output [or value added].

Input-output models are most commonly used to analyse the economic effects of a specific project from a planning perspective (Powell 1991, p. 1). Jensen and West (1986, p. 80) provide a four stage classification of input-output impact studies covering most applications of the technique. These include research work into the economic significance of a particular industry or firm and studies examining the impact of a change to final demand for a specific firm or industry. Employing input-output analysis to study the economic benefits of saleyards would lie within the first of these categories. Other applications focus on the result of changes within the transaction table, such as a change in technology, while the final category of research examines changes outside the transaction table. This final category includes examination of the effects of pollution, energy requirements and the like. [For a comprehensive review of the types of studies undertaken using input-output analysis see, for example, Powell 1991].

Input-output models face a number of specific constraints. Firstly, there is an assumption of constancy. This implies that the coefficients depicted in the A matrix remain unchanged over the time period of any investigation. Use of the input-output tables compiled in 1993, for example, assumes that the coefficients remained constant both during the assembly of the input-output tables and since the date of their assembly in 1993. Secondly, there is an assumption of linearity within input-output analysis. Linearity extends the assumption of constancy so that it applies to all levels of production under analysis (Jensen and West 1986, p. 47). For example, changes in output for the agricultural sector always produce marginal changes in related input sectors consistent with the coefficient matrix.

The limitations of input-output analysis are not restricted to assumptions of linearity and constancy. The literature also cites a variety of unresolved controversies ranging from the effects of flexible input prices and consequent input substitution to the impact of altered model specification within computational packages [see, for example, Rickman and Schwer 1995; Sancho 1992]. Such issues are generally beyond the scope of this project. Rather we shall proceed with an acceptance of the constraints imposed by assuming linearity and constancy. Moreover, assumptions of linearity and constancy should not be viewed as unduly restrictive given that the alternative Keynesian and economic base multiplier methodologies have similar limitations (Jensen and West 1986, p. 47).

Recent advances in the construction of transaction tables accompanied by developments in computer technology have seen a growth in the application of input-output techniques at the regional level. Regional input-output tables, although generally unavailable, can now be derived at relatively low cost. Formerly, survey based tables could only be derived where researchers were able to devote considerable financial and human resources to their production. In the 1970's a technique was developed at the University of Queensland which enabled the production of regional tables from national input-output tables. This technique which became known as GRIT [Generation of Regional Input-Output Tables] produces 'prototype' regional tables through a series of mechanical steps which provide for the insertion of superior regional data at several stages during their construction (Jensen and West 1986, p. 6). Extensions of this technique, such as the RAS technique used by the ABS are also widely employed. This method takes existing input-output tables through a process of iterative adjustment to meet some predetermined constraints derived from regional data (Business Connect 1993, p. 21). In common with the GRIT technique developed in the 1970's, the RAS technique often begins with national input-output data.

The RAS technique was used by a consulting team conducting a study into the industry profile of the Albury-Wodonga statistical district. The study, conducted in 1993 and funded by the Federal Office of Labour Market Adjustment, used national input-output tables as the initial basis of the input-output analysis (Business Connect 1993, p. 13). Constraints were derived from surveys of businesses in the regional area between 1990 and 1991 and included values of output and wages for specific sectors. The resulting transaction table was able to both regionalised and updated the initial national tables (Business Connect 1993 p. 13).

Modified Keynesian Multiplier Estimation

An alternative estimate of multiplier effects can be obtained by modifying Keynesian multiplier methodology to regional circumstances. The principle underlying the Keynesian methodology focuses on the flow of income and employment generated by some change in an autonomous element of expenditure. In its simplest form the multiplier is determined by examining the leakages that leave the regional economy at the various stages of expenditure. The total impact of a project or industry can then be estimated as subsequent rounds of expenditure and employment ripple through the regional economy until extinguished by the relative magnitude of these leakages.

Regional Keynesian multiplier estimation lends itself to adaptation where the initial round of expenditure differs qualitatively to subsequent rounds of expenditure. This may be particularly appealing where assessment is required of the economic impact of a facility under construction. Glasson, Der Wee and Barrett (1988), for example, used a modified Keynesian multiplier to estimate the income and employment impacts of a proposed nuclear power development in England. The Keynesian multiplier methodology was used since it could be adapted to allow for the disaggregation of expenditure by construction and operational categories. Further disaggregation made it possible to treat the expenditure of the in-migrant workforce separately to that of local recruits. Similarly, Nairn and Swales (1987) employed a modified Keynesian multiplier to estimate the effects of urban renewal programs in Scotland. Again the attraction of this methodology was the ability to distinguish the first round injection, which was not generally related to local consumption expenditure, from subsequent rounds of expenditure.

Estimating Keynesian multipliers rests on the ability to judge individual propensities to save, import, pay tax and the like. Thus, a sound information base is generally required for the construction of estimates and any assessment of the economic impact of major projects "...can only be as good as the information sources on which it is based" (Glasson, Der Wee and Barrett 1988, p. 259). Since the requisite data are generally unavailable for a regional analysis of saleyards it is not possible to employ this methodology. Moreover, as the saleyards infrastructure included in this analysis are not currently undergoing construction little would be gained from the use of this methodology in preference to currently accessible input-output tables.

Economic Base Multipliers

Economic base multiplier estimation is achieved by dividing a regions' productive activities between an exogenously-oriented sector and endogenously-orientated sector. These sectors are commonly referred to as the basic and non-basic sectors respectively. Generally it is contended that the ratio of basic to non-basic activity remains constant while changes in the non-basic sector derive solely from changes in the basic sector (Merrifield 1987, pp. 283-286). The usual assumption adopted in this bifurcation technique is to regard agriculture, mining and manufacturing as comprising the basic sector, while the non-basic sector is assumed to comprise utilities, construction, commerce, transportation, communications and services (Thompson 1983, p. 72). Employment and output from these industries is allocated to the appropriate sectors under this assumption and a relationship between aggregates is established by assumption and statistical estimation. Assumptions can be Keynesian in nature where price change is excluded from the economic base model. Alternatively, output and factor price flexibility can be included to permit examination of supply side conditions within the regional economy.

Economic base multipliers are frequently employed to analyse the dynamics of regional centres of different size and order as well as the relationships between centres [see, for example, Thompson 1983]. Such studies have focussed on the aggregate nature of industry dynamics rather than the specific impact of a particular industry or firm. This limits the application of this methodology in this study. Moreover, it has been shown that the bifurcation process is not well suited to industries with activities which span both basic and non-basic sectors. The resulting multiplier estimates will therefore be biased by such a methodology since saleyard activity cannot clearly be classified as either basic or non-basic.

It would therefore appear that input-output analysis is the most suitable methodology for the present study. The appeal of this methodology rests on both the relative availability of reliable data and the capacity of the technique to assess multiplier impacts relating specifically to municipal saleyards. However, while input-output analysis would appear to be the most appropriate methodology, a number of other issues arise concerning the inclusion of such multiplier estimates.

The appropriate treatment of saleyards within input-output analysis is to include saleyards as a separate column within a regionalised input-output table. However, this may create some mis-specification within the overall CBA framework. In this respect it is worth noting comments by Tietenberg (1992) when detailing the criteria for the inclusion [exclusion] of employment multipliers within any CBA.

> "... [I]n general secondary employment benefits should be counted in high unemployment areas or when the particular skills demanded are under employed at the time the project is commenced. They should not be counted when the project simply results in a rearrangement of productively employed resources." (Tietenberg 1992, p. 84)

Thus, if change to saleyard facilities merely results in a rearrangement of productively used resources, inclusion of employment multipliers would appear to be unwarranted. There are three main areas where inconsistencies between CBA and traditional multiplier estimation make the application of traditional methodologies inappropriate.

Firstly, total incomes earned by those municipal employees working at saleyard venues may overstate the multiplier impact of saleyards. In many cases, the operation of the saleyard venue by municipal employees forms only a portion of their total workload. The closure of a saleyard may be more likely to see a reallocation of these employees to other duties rather than a cessation of their employment and income. Using input-output analysis to assess the economic significance of saleyards is therefore likely to overstate the relative importance of the saleyard to the regional economy.

Secondly, the activities of selling agents may not necessarily be reduced by curtailing saleyard activity. Anecdotal evidence collected on behalf of the MRC suggests that some livestock selling agents would not change their employment levels if the local saleyard was to close (Orton Agribusiness 1993, p.33). Presumably, these agents relied heavily upon other selling methods, such as CALM and direct selling. It may also be plausible that even those agents who claimed a reduction in employment following the closure of a saleyard facility would reallocate their employment efforts to other methods of livestock selling. Similarly, transport operators may confront a similar reallocation of employment rather than a reduction in total employment from the closure of a local saleyard. Moreover, the increased selling of livestock directly to processors could conceivably see an increase in employment for livestock transport firms. Again using input-output analysis is likely to overstate the economic significance of multipliers related to such facilities, since closure is more likely to reallocate regional employment and income rather than cause a direct reduction.

Finally, it is worth considering the widely held view that saleyard facilities generate additional indirect spending within the community that funds the saleyard. Specifically, it is argued that livestock producers, drawn by the saleyard complex, choose to undertake expenditure locally on other goods and services provided by the community which sponsors the saleyard. In the context of this study it is this additional expenditure which warrants inclusion within the CBA framework rather than the multiplier impact of all saleyard activity. However, such expenditures can only be regarded as an indirect benefit of the saleyard facility if they can be attributed solely to the existence of the saleyard facility. There are a number of reasons why this view cannot be adequately tested by input-output analysis. Input-output analysis is unable to distinguish this purported additional spending from any spending that livestock sellers would have undertaken in the normal course of events. Input-output analysis specifies linkages between firms and sectors within the regional economy on the basis of existing spending and production patterns. While the input-output table can detail the repercussions of additional expenditure flowing to livestock producers there is no facility for testing the motivations for this expenditure. More particularly, there is no facility for testing whether this additional expenditure is induced by the presence of the saleyard. It is therefore necessary to develop an alternative methodology for testing the veracity of this claimed indirect saleyard benefit.

3.1.2 Estimating Relevant Multiplier Effects for Municipal Saleyards

Those techniques traditionally used in economic analysis to estimate multiplier effects cannot be used in this case because of their inconsistency with the CBA framework and their inability to define indirect expenditures which arise solely from the saleyards existence. Direct employment and expenditure multipliers can justifiably be excluded from the analysis although it is clearly necessary to test the claim that indirect expenditure is attracted by the presence of a saleyard facility within the regional community. Survey methodology provides the opportunity to address the latter of these issues since there is generally no other suitable source of data or identified methodology.

Two different survey methods may be used here to test the indirect benefits derived from the presence of a municipal saleyard in a community. The first methodology requires the collection of primary data on the expenditure patterns of saleyard users. This data can then be used to trace those expenditures which are contingent on the existence of the saleyard facility. A second survey method draws from the contingent valuation method [CVM] frequently used to measure the value of non-market environmental goods. Rather than collecting data from saleyard users, data can be collected from business firms likely to benefit from any additional expenditure generated by the saleyard facility. Hanemann's

(1984) utility theoretic view is that an individual will be willing to pay [WTP] a specified amount for the provision of an [environmental] good provided that the post-purchase state leaves the individual with at least the same level of utility as the pre-purchase state. Moreover, an individual's original utility function may given by:

$$U_1 = f(0, y, s) \tag{3.1}$$

where 0 is some base state of the individual's environment, y is the income of individual I, and s is a vector of other variables likely to influence an individual's willingness to pay. Thus, an individual will be WTP a specified amount, $\$C$, provided that $U_2 \geq U_1$, where:

$$U_2 = f(1, y - C, s) \tag{3.2}$$

and 1 is some future state with greater quantity or improvement to the [environmental] good. It may be possible to transpose this view to the problem of identifying the value of additional expenditure generated by saleyard facilities. Under assumptions of complete and accurate knowledge, business firms who benefit from any such additional expenditures would be WTP an amount at least equal to the value of profit derived from additional expenditure. It would thus be plausible to use this technique to quantify such benefits.

Using surveys to assess the value of conventional government services is a relatively recent adaptation of the CVM. One noted example was the study by McLeod, Roberts and Syme (1994) which used the CVM to value agricultural protection services provided in Western Australia. Estimates of over $10 million dollars were derived from the constructed market questionnaires. These estimates "..exceed[ed] substantially the annual costs of providing [these] services" (McLeod, Roberts and Syme 1994, p.1) and have been used to justify their continued provision. The survey used in this study employed both dichotomous choice and open-ended questions.

While much of the literature in recent years has focussed upon appropriate questions for eliciting WTP responses the issue is largely resolved by constraints on the nature of this study. Firstly, restricting the survey to a smaller relatively isolated saleyard is desirable since it provides a comprehensive sampling frame of the population of businesses affected by any additional expenditure. However, since dichotomous choice questions generally require larger samples for accurate estimation, it is necessary to rely on open-ended WTP questions to estimate the value of these additional expenditures (Carson 1991, p. 145). [For a more complete treatment of issues relating to the structure of WTP questions see, for example, Crase 1996, pp. 101-103]

Secondly, the issue of WTP versus willingness to accept [WTA] is resolved, in part, by the political sensitivity of such surveys. Discrepancies between results from WTP and WTA questions have generally proved to be "...an embarrassment to practitioners of CVM" (Bishop and Herblein 1986, p. 138). WTP questions and WTA questions are based on an acceptance of Hicksian compensation principles and imply measures of compensating variation and equivalent variation respectively. Since either measure can be used to derive Hicksian demand curves, WTP and WTA questions should result in similar estimates of value. Unfortunately, this has tended to be the exception rather than the rule with writers frequently reporting discrepancies between WTP and WTA estimates of similar goods [see, for example, Knetsch and Sinden 1984]. In this study the choice between WTP and WTA is dictated by knowledge of the political sensitivity of suggested closure of saleyard facilities.

Specifically, the mooted closure of local saleyard facilities is likely to render the application of any survey methodology prone to significant strategic biases from respondents.

The use of the above survey methodologies provides for the specification and measurement of the relevant multiplier impacts of municipal saleyards. Moreover, the different methodologies provide a vehicle for testing the veracity of results from alternative sources of data. In addition, since data can be collected from both large regional saleyards and smaller isolated saleyards, there is scope for some preliminary comparison of the relative magnitude of the additional expenditure effects provided by municipal saleyards of different sizes.

3.2 Saleyards and Market Information

A precursor to efficient market outcomes is the availability and use of perfect and complete information by all parties to the market process. As indicated in chapter one, producers, in particular, rank highly the information that they gain from saleyard venues. Such information may not only improve the efficiency of the livestock market but be of value in itself to the market participants. Moreover, any comprehensive review of the costs and benefits of saleyards requires an examination of any betterment derived from the market information available from saleyard venues. In order to fully appreciate this betterment it is necessary to briefly review literature which explores the operation of markets with imperfect information.

3.2.1 The Benefits of Perfect Information

Following Carlton and Perloff (1994, pp. 555-556) there are several reasons why imperfect information may arise. Firstly, the information itself may be inaccurate and unreliable. Secondly, the cost of collecting information implies that even rational market participants will not access all available information. Rather, information will be accessed up to the point where the marginal cost of collecting such information is equal to the marginal benefit derived from that information. Thirdly, it is not possible for human market participants to retain all information. Bounded rationality (Williamson 1964) derives partly from an inability to retain all information. Individuals, faced with their own human limitations, will therefore categorise and order information in an effort to make rational profit-maximising or utility-maximising decisions. Finally, the limitations of human beings may be such that they lack the skills, knowledge or intelligence to process information on products even within a bounded rationality framework.

The consequences of imperfect information on market outcomes has also been well explored. A variety of models have been presented to trace the impact on pricing where information is less than perfect. In his classic study of the market for used cars Akerlof (1970) showed that a bias of information in favour of sellers leads to either the collapse of the market altogether or transactions in only lower quality goods. Moreover, this information asymmetry and the consequent adverse selection results in a divergence from the efficient outcomes typical of competitive markets. In effect, imperfect information makes it impossible or impractical for the producers of high quality outputs to internalise the benefits of quality production. In these circumstances quality becomes an expensive externality which places the firm at a cost disadvantage relative to the producers of inferior outputs.

Making information perfect may, in many cases, be impractical given the costs involved in collecting and processing such information. However, improving the symmetry with which information is distributed between market participants can intuitively produce outcomes which more closely resemble those of competitive markets [see, for example, Stiglitz 1989; Salop 1978]. This may have particular significance in livestock markets where producers are frequently suspicious of processors and lack the information and knowledge to benefit from longer term contractual selling arrangements (AACM 1995, p. 9).

Modelling of the costs involved in the collection of information and the effect of limited information on market power is also a theme within the literature. Tourist-trap models, for example, suggest that firms will maintain sales at prices in excess of the competitive price where search costs are positive (Carlton and Perloff 1993, p. 569). Such conclusions imply that firms gain market power from imperfect asymmetric information and may be well served to generate price and quality dispersions within the market. These dispersions raise search costs and thereby increase market power (Scitovsky 1950). However, incremental reductions in search costs alone will not bring prices into line with costs. Only when search costs are completely eliminated can the efficiencies generated by the neo-classical competitive market be captured (Carlton and Perloff 1994, p. 571).

The modelling of 'tourist' behaviour has been extended by considering markets where both uninformed 'tourists' operate alongside informed 'native' market participants (Carlton and Perloff 1994, p. 572). Generally, these models emphasise the relative size of the two categories of market participants. As the proportion of 'native' market participants increases, the market price converges on the competitive equilibrium price. However, market power can again be derived from imperfect knowledge. Sellers, by raising search costs, can effectively alter the slope of their respective demand curves and approach monopoly price settings.

3.2.2 Valuing Market Information from Saleyards

Clearly market information can exert a powerful influence over market performance. It is this relationship which undoubtedly induces many market participants to acquire superior information or even prevent other market participants from acquiring access to information. In most cases the literature on imperfect market information has implied asymmetry in favour of the seller within the market. Much of the discussion therefore focuses on the increase in monopoly power enjoyed by sellers endowed with an asymmetrical information distribution. However, in many agricultural markets the distribution of information favours buyers of agricultural outputs rather than the producers of those outputs. In such agricultural markets it may be more appropriate to address the asymmetry of information in terms of monopsony power rather than monopoly power.

In reviewing the operation of the Flemington fresh fruit and vegetable market, for example, Tunstall (1992) noted that control of market information by buyers or wholesalers was crucial to the maintenance of market power by buyers and the relative subjugation of sellers. This market power related directly to the private treaty method of sale and the absence of a competitive and open auction system. Moreover, given the bargaining power afforded by such treaties to buyers, they were "... unlikely to yield this component of their market power willingly" (Tunstall 1992, p. 64). This was deduced from evidence of resistance by buyers to complete compulsory manifests, which detail objective data on quantities of exchanged produce. Similarly, buyers displayed reluctance in supporting a computerised Flemington Market Reporting Service which was to provide accurate information on current prices.

Clearly, market power, and the financial benefits that derive from that power, can be partly traced to the "...information that [buyers] possess [and] the extent to which they are able to control the flow of information" (Tunstall 1992, p. 63).

As we noted in section 3.2.1 there is a similarly perceived bias of information in livestock markets in favour of buyers. If the theoretical treatment of this bias is correct, there will be a resultant shift of market power towards buyers. Presumably this will be particularly significant in livestock saleyards where there are relatively few buyers and collusive behaviour becomes practicable. Under such circumstances producer gains from any increase in market information will be significant since such information provides a degree of countervailing power against potential monopsony or oligopsony. However, rational producers will not access all information. Rather their preference will be to access information up to the point where the marginal benefits of that information equate to the marginal costs of that information. Accepting this theoretical framework permits an assessment of the value of market information derived from saleyards.

Studies of livestock market intelligence on behalf of the MRC indicate that producers recognise the value of market information expressing a mean WTP of $79 per producer annually for additional market information (AACM 1995, p. 13). However, such estimates show no deliberate effort to disaggregate the value of current sources of livestock market information. Empirical research into non-market environmental goods reveals two broad approaches available for assessing the specific value of saleyard information. Firstly, the CVM technique could be used to ascertain the mean WTP for the information that producers currently gain from saleyards. And secondly, the travel cost method [TCM] could be employed to reveal such valuations.

As we saw the CVM uses survey methodology to construct a scenario where respondents reveal their preferences via WTP questions. WTP questions which require respondents to disaggregate their WTP for saleyard information from other sources of livestock market information create difficulties partly because the value set surrounding such issues is unlikely to be well defined by the individual. Since producers have previously been able to access saleyard information without direct payment, individual valuations of saleyard information place considerable cognitive demands upon respondents. These demands stem from the lack of experience associated with directly paying for goods which, to date, have generally been regarded as free. Questions asking respondents their WTP for saleyard information also seem likely to invoke strategic biases and protest zero responses because of the anxiety created by such questions. Finally, WTP questions about saleyard information are also likely to be subject to problems of embedding where respondents, unable to disaggregate the value of saleyard information, aggregate other issues within the valuation framework. This could manifest itself in the aggregation of all market information within the valuation or the aggregation of all services provided by the saleyard in question. [For a complete treatment of issues surrounding embedding within WTP responses see, for example, Lockwood 1992].

An alternative approach is to use the TCM. This technique was first suggested by Hotelling in 1947 as a method of estimating the value of environmental services (Johansson 1991, p. 128). Later, Clawson (1959) and Clawson and Knetsch (1966) developed the first empirical models along the lines suggested by Hotelling (Bateman 1993, p. 192). In its simplest form the TCM uses the expenditure incurred by individuals in visiting a particular site as a surrogate for the price paid to acquire the benefits available at that site. This kind of model assumes a specific relationship between the cost of travelling to a site and the utility gained by individuals from such visits. Survey responses from site visitors are used to source data on travel distances, trip information, socioeconomic features of respondents and the like. These data are then used to construct a Marshallian demand curve with estimates of consumer surplus used to derive a total value of the site. The TCM could be employed in this case by surveying producer visits to saleyard venues and assuming that visits are primarily for the purpose of gathering market intelligence. Given that few other attractions can be attributed to such venues, assumptions of this nature should not prove unduly restrictive.

The TCM generates a trip generation function similar to that described by:

$$V = f(C, X) \tag{3.3}$$

where V is the number of visits to a site, C are the costs of the visit and X represents other socioeconomic variables which explain the number of visits. Changes to the visitation rate, V, can then be mapped against changes in the cost, C, by assuming that visitors would respond to increments in a hypothetical entrance fee. Bennett (1996, p. 4) notes that the TCM methodology requires an acceptance of three basic assumptions. Firstly, the benefit arising from any visit by one individual is equivalent to that of another who has incurred similar travel costs. Secondly, the consumer surplus attributed to the most distant visitor to a site is zero. Thirdly, visitors from a particular zone or region bear similar travel costs to other visitors from the same region. The last of these assumptions is most significant when employing the zonal TCM rather than the individual TCM.

The zonal TCM redefines equation (3.3) by constructing concentric travel distances around the site and transposing information to the total population within these zones. The generalised form for a zonal TCM can be represented by:

$$V_{hi} / N_h = f(C_h , X_h) \qquad (3.4)$$

where V_{hi} represents visits from zone h to site I, N_h is the total population of zone h, C_h is the cost of travel from zone h, and X_h are other socioeconomic variables in zone h. The visitor rate , V_{hi} / N_h, is often expressed as visitors per thousand. Since this version of the TCM requires the aggregation of data into zones, important explanatory variables provided by visitors may be diluted within the model (Bennett 1996, p. 4). Moreover, use of the individual TCM enables the modelling procedure to be expanded to encompass a wider range of factors which help explain the behaviour of individuals.

The individual TCM allows for the inclusion of a host of individual-specific variables relevant to the site visitor. An example of an individual trip generation function described by Bateman (1993 p. 203) is represented in equation (3.5) below:

$$V_{ij} = f(C_{ij} , E_{ij} , S_i , A_i , Y_i , H_i , N_i , M_i) \qquad (3.5)$$

where V_{ij} is the number of visits made per year by individual I to site j, C_{ij} is individual I's costs of visiting site j and E_{ij} represents the estimate by individual I of the proportion of the days enjoyment attributable to site j. The other explanatory variables, S_i , A_i , Y_i , H_i , N_i and M_i , reflect the availability of substitute sites as assessed by the individual, age, income, household income, size of travelling party and membership of outdoor organisations relevant to individual I respectively. The choice between the individual TCM and the zonal TCM is determined largely by the frequency of site use by surveyed individuals. Where a large proportion of those surveyed make recurrent visits to the site, the individual TCM is likely to be more appropriate (Bennett 1996, p. 4). Since it is assumed that the purpose of producers travelling to a saleyard is to accumulate first hand market information, continued operations within the livestock market would require frequent trips to remain abreast of market developments. The individual TCM is therefore preferred as a method for assessing the benefits that accrue from saleyard information.

A number of other general issues surrounding the use of TCM also deserve mention. One of the most frequently raised issues in applying the TCM is the appropriate costing of an individuals' time in travelling to a particular site. Economic theory postulates that the appropriate cost is the opportunity cost; that is, the cost of the alternative foregone. Where an individual travelling to a site forgoes time that would have normally been spent working, it is appropriate to attribute the marginal wage rate to travelling time by visitors. However, individuals who would have otherwise enjoyed leisure elsewhere should have a zero cost attributed to travelling time. Moreover, some individuals may gain utility from the journey itself, particularly where the trip is part of a wider leisure activity. Given the nature of the problem under investigation, it seems appropriate in this case to include travelling time within the travel cost estimation and attribute the marginal wage rate to such time.

A further issue relates to estimation of benefit where a visitor frequents a number of sites on any one trip. Under such circumstances it becomes necessary for survey respondents to apportion the relative importance of any one site to the overall journey. This issue is likely to be of significance in the present context. Specifically, visitation to saleyard venues by producers to gain market information may well coincide with a variety of other purposes.

Indeed, the discussion throughout section 3.1 centres on the hypothesis that those attending saleyard venues generate additional income for others in the surrounding region via additional expenditure. Use of the TCM here must therefore provide for an individual assessment of the relative importance of the various components of any one journey. Failure to do so is likely to inflate the estimated benefits of saleyards by double counting the indirect benefits described in this chapter.

Issues of functional form are also prominent in discussions of the application of the TCM. In the absence of any pressing theoretical constraints, most researchers have opted to experiment with a variety of functional forms to depict the relationship between travel cost and visitations. Linear, quadratic, semi-log and log-log specifications are all found in the literature. None would appear to be superior on theoretical grounds alone although "...log forms may be useful for elasticity estimates and have the advantage of avoiding negative values for the dependent variable" (Bateman 1993 p. 223).

Finally, it is worth noting that use of the TCM as a technique for assessing the benefits of saleyard information is likely to underestimate the value of such information. Firstly, attendance at livestock markets is not always necessary to access livestock market information. Summary data are available at little or no cost via the press, electronic media and livestock agents. Moreover, "...the importance of [saleyard] auction[s] in the generation of prices in the beef cattle market was explicitly recognised with the introduction of independent market reporting of auctions by the various livestock authorities throughout Australia in the late 1970's and early 1980's" (Williams, Rolfe and Longworth 1993, p. 169). As a result of such services, producers can acquire saleyard information and the benefits of this information will remain largely undetected by the TCM. Only where producers perceive the need to collect information first-hand will this technique adequately quantify such benefits. In short, the TCM does not fully capture the pivotal role played by saleyards in determining livestock prices in other livestock markets.

Secondly, it has been assumed throughout that producers gain the largest benefit from saleyard information since buyers and processors have access to a wider and more refined network of market intelligence. However, part of this network is saleyard information. Isolating the population of information beneficiaries to livestock producers discounts any benefits accruing to livestock buyers and processors.

3.3 Saleyards and Loss of Environmental Amenity

Section 1.3.1 detailed the loss of environmental amenity created by saleyards. The same section also identified the limitations of providing a generalised assessment of this loss and problems associated with including this loss within policy recommendations. However, in the interests of completeness these issues are discussed in greater detail to enumerate issues introduced in chapter one.

3.3.1 Sources of Detrimental Externality

Saleyard activities generate negative externalities in three main ways. Firstly, odour associated with large volumes of livestock in high concentrations imposes environmental costs on nearby residents. The attendant generation of disease-carrying insects may also impose costs in this regard. Secondly, livestock are not always delivered to saleyards facilities in daylight hours. In order for producers to minimise stress on livestock while meeting live weight weighing curfews, stock will generally be delivered in the evening prior to sale. The resulting noise and lighting further disrupts local residents within the immediate vicinity of the saleyard. The frequency of heavy transport may also impose costs upon more distant residents. The third source of detrimental externality is the solid and liquid waste generated by livestock selling facilities. While many newly constructed or renovated saleyards are equipped with on-site treatment and recycling of effluent, older facilities rely on municipal sewage facilities for the disposal of saleyard waste. While full discourse on the costs of sewage disposal and livestock waste disposal is beyond the scope of this study it can safely be assumed that saleyard effluent imposes broader costs on the wider community. [For a complete treatment of the costs of effluent disposal, including the cost of livestock effluent see, for example, Herath 1996].

Increased community consciousness of environmental degradation and related issues also implies that such costs cannot be ignored in any study of saleyard facilities. While other methods of livestock selling may impose similar total costs, the diffuse nature of their operations is likely to leave their activities concealed from the community and policy makers. By way of contrast, saleyard venues concentrate these costs through high density livestock populations. They are therefore more likely to be subject to community scrutiny.

3.3.2 Measurement of the Loss of Amenity

Estimating the cost associated with despoiling the environment can be achieved through the application of the hedonic pricing model [HPM]. The HPM establishes the value of environmental detriment by disaggregating the pricing characteristics of other goods exchanged within a market. The market most frequently used to apply the HPM is the real estate market. For example, a residential dwelling located in close proximity to a saleyard venue is more likely to attract a lower market price than a similar dwelling not subject to the aforementioned externalities. If the pricing characteristics of all dwellings could be 'unbundled' it would be possible to use statistical techniques to distinguish those price differentials solely attributable to the loss of amenity created by the saleyard venue. An inverse market demand curve could then be used to estimate the total impost of these externalities.

The first discernable HPM study was conducted by Ridker (1967) although the notion that the price of a parcel of land reflects the attributes of that land can be traced to Ricardo (Bateman 1993, p. 233). The HPM is founded upon a number of theoretical concepts. Following Johansson (1993) and Pearce and Nash (1993) we first identify an implicit house price function:

$$P=f(z) \tag{3.6}$$

where z is some vector of the attributes of housing, including the loss of amenity because of proximity to a saleyard venue. It is assumed that households have utility functions identified by:

$$U = U(x, z) \tag{3.7}$$

where x is a bundle of non-housing commodities, and equation (3.7) is maximised against some budget constraint:

$$B = px + f(z) \tag{3.8}$$

Use of the Lagrangian multiplier associated with equations (3.7) and (3.8), λ, yields:

$$f_i(z) = U_i(x,z)/\lambda(x,z) = g(y\text{-}P,z) \tag{3.9}$$

where $f_i(z) = \partial f / \partial z_i$ and $U_i = \partial U / \partial z_i$. Equation (3.9) suggests that consumers will be willing to consume z_i up to the point where the marginal willingness to pay for z_i is equal to the price of z_i (Johansson 1993, p. 60). Where a linear utility function is assumed, $\partial P / \partial z_i$ will be represented by some coefficient in the regression equation. However, since linear utility functions seem implausible "...the hedonic price function is likely to be non-linear" (Bateman 1993, p. 138). Moreover, multiplicative utility functions, for example, yield double-log hedonic price functions where the hedonic price becomes dependent on the current property value as well as the current level of the housing attribute *I*.

A further constraint upon the HPM derives from the interpretation of $\partial P / \partial z_i$, the marginal willingness to pay for an extra unit of the housing attribute *I*. More specifically, $\partial P / \partial z_i$ can only be treated as the demand function for z_i where all households have identical and homogenous utility functions and incomes (Johansson 1993, pp. 60-61; Bateman 1993, pp. 239-241; Pearce and Nash 1993, p. 138). This implies that all observations relate to a single demand function for the housing attribute under examination. Given the implausible nature of such an assumption, empirical HPM studies can be criticised as single observations of many functions rather than multiple observations of a single hedonic price function (Pearce and Nash 1993, p. 139).

An additional problem arises with the constraints which must be imposed on the supply side of the housing market. HPM effectively assumes that the supply of the housing attribute *I* is exogenously determined. If the supply of housing attributes becomes endogenously determined then identification problems arise. In particular, if supply conditions are also a function of the implicit price it becomes difficult to distinguish those observations which can be justifiably attributable to demand and those which can be attributed to supply. Where supply is elastic, it becomes necessary to specify both the demand and supply sides of the market and impose assumptions of homogeneous and indistinguishable cost functions. [For details of restrictions imposed by assuming endogenous supply see, for example, Nelson 1978].

The theoretical restrictions of the HPM is not unique to this form of economic analysis. More specifically, the HPM will only be valid where households adopt utility maximising behaviour constrained only by income and markets operate with perfect knowledge and mobility. Pearce and Nash (1993, p. 138) observe that "...of all the markets, however, the housing market is the one in which such an assumption is least likely to be met since many factors besides income determine mobility and choice of location" (Pearce & Nash 1993, p. 138).

A number of additional operational complexities arise in the application of the HPM in this study. Firstly, the HPM most frequently uses the residential housing market to imply a value for despoiled amenity. Where saleyards are located in residential areas it is feasible to apply a similar methodology. However, growing public concern and developments in building regulations have seen the relocation of many municipal saleyards to industrial areas. Where this is the case it may be difficult to distinguish the environmental impact of saleyards from surrounding industrial facilities. The location of a saleyard adjacent to an abattoir, for example, would restrict the practical application of the HPM since it would be difficult to distinguish that loss of amenity which was solely attributable to the saleyard. Moreover, the location of the saleyard in such conglomerate industrial sites may produce positive spillover effects which are unlikely to be captured by the HPM. The abattoir may well benefit from its relative proximity to the saleyard facility, but there is some doubt whether this benefit can be traced through property values. Similarly, surrounding rural properties may be positively effected by the proximity of a saleyard since close proximity implies reduced transport costs when acquiring and selling livestock. Where practicable, sample selection would need to be extended to include those properties that may benefit from proximity to the saleyard as well as those which suffer some loss of amenity. Given the theoretical foundation of the HPM on identical utility functions, the application of the HPM in this case is likely to be troublesome.

Secondly, values obtained from the HPM on the indirect costs associated with loss of amenity imply that these costs are external to the organisation responsible for their generation. In reality a portion of these costs is internalised by the municipal government responsible for administering the saleyard facility. Municipal governments acquire a large proportion of their revenue from land rates estimated on the basis of property values. Since lower property values attract lower rate payments, municipalities bear part of the cost of the loss of amenity generated by saleyards.

Thirdly, chapter one noted the site specific nature of any loss of amenity derived from saleyards. This specificity reduces the portability of results between saleyard venues. Moreover, it is not possible to use HPM estimates in a generalised analysis except as caveats upon policy recommendations and conclusions. Critics may therefore argue that such an approach reduces to little more than anecdotal description.

3.4 Summary

The indirect issues to be included in the analysis of municipal saleyards are the additional regional expenditure attracted through the presence of the saleyard and the value of livestock market information. In assessing the value of additional regional expenditure it was noted that traditional multiplier analyses were inconsistent with the CBA framework employed in this study. Consequently, it becomes necessary to borrow from other methodologies. In particular, both the CVM and survey data will be used to test the value of any additional regional expenditure solely attributable to the continued existence of the saleyard facility. Moreover, these methodologies will be tested on saleyards of different size to provide preliminary estimates of the relative importance of saleyard venues in both small and large regional economies.

Similarly, no traditional technique is readily available to quantify the benefits of market information gleaned from saleyards. Methodologies usually reserved for valuing environmental goods can again be adapted to provide estimates for inclusion within the broader CBA framework. The TCM will be used to estimate the benefit derived by producers from first hand market intelligence available at municipal saleyards. However, such estimates should be treated cautiously given the probable bias towards underestimation.

Finally, while the HPM offers scope for estimating the loss of amenity attributable to saleyard venues these estimates would be largely reduced to caveats on policy recommendations. Moreover, there are a number of theoretical constraints which restrict the veracity of results obtained via this methodology.

Chapter 4

4.0 Introduction

Chapter two introduced the theoretical foundations of economic cost and revenue. It was assumed that the direct costs and benefits of saleyards could be analysed within these constructs. Appropriate techniques for estimating the value of these direct costs and benefits were then examined with special emphasis on statistical estimation techniques. It is the purpose of this chapter to apply those estimation techniques to data collected on municipal saleyards in Victoria.

The chapter itself comprises five main parts. Part one uses time series data collected from a single saleyard in an attempt to derive a short-run cost function for a livestock saleyard. It seeks to highlight many of the technical difficulties confronted by those seeking to apply economic constructs to accounting data. The second part of the chapter focuses on long-run cost estimation, including discussion of the sampling frame and methodology employed to derive long-run functions. The third and fourth parts of the chapter focus on revenue estimation within the short-run and long-run sampling frames respectively. The chapter concludes with analysis of minimum efficient scale [MES], profitability, and efficient pricing. It is this analysis which will be carried to the broader CBA in subsequent chapters.

4.1 Estimating Short-Run Costs

The critical prerequisite of short-run analysis is the fixed nature of at least one input. Chapter two emphasised this point and explained why analysis of a single firm is most likely to comply with the short-run construct. For these reasons statistical estimation of short-run costs was attempted for a single municipal saleyard; Wodonga.

4.1.1 Sampling Frame for Short-Run Cost Estimation

The Wodonga livestock selling complex was chosen as the saleyard venue for estimating a short-run cost function for six main reasons. Firstly, the Wodonga selling complex has generated the largest throughput of cattle of any Victorian saleyard since 1990 (Municipal Saleyards Association, 1996). Since the 'homogenous output' selected for this study was cattle it is appropriate to use a saleyard venue where cattle throughput is paramount.

Secondly, the saleyard complex opened in 1980 and the infrastructure at the complex has remained largely unchanged since 1981. Thus, by restricting the data to the period 1980-81 to 1995-96 it would be possible to control for cost variability due to changes in plant scale and technology. Such controls would ensure that cost data more closely conformed to the short-run cost construct. Unfortunately, restricting the data to control for variations in technology and plant scale also reduces the number of cost-output observations. Moreover, since records of throughput and cost are only available on an annual basis, this provides a data set of only sixteen observations. Thus, at the outset it is important to recognise that estimation based upon such a relatively small number of observations must be treated cautiously.

The third reason for selecting the Wodonga selling complex was the comprehensive set of accounting records held by the City of Wodonga. Interestingly, this is not the case for all saleyard complexes in Victoria. Some municipalities previously aggregated the accounts of saleyard facilities with other municipal activities, largely concealing the costs and revenues of the saleyard. This is particularly relevant to the period prior to 1990.

Fourthly, the Wodonga saleyard was included in a review of saleyard selling conducted by Orton Agribusiness (1993). Financial data available in their report was therefore available to supplement and verify accounting data available from the council.

Fifthly, the accounting records held by the City of Wodonga were largely undisturbed by the amalgamation of municipalities and appointment of Commissioners in Victoria in 1992. In other cases the amalgamation of councils has seen significant changes to both accounting procedures and the operation of some saleyards. In the Baw Baw Shire, for example, previously separate and independent saleyards are now administered by a single municipal government. The absence of such disruptions at the Wodonga selling complex was likely to produce data suitable for the estimation of economic constructs.

Chapter two noted that successful cost estimation was contingent on close liaison between those directly involved in the operation and management of a saleyard and those seeking to estimate cost functions. The expressed willingness of executive officers from the City of Wodonga to be actively involved in this research, and the close geographic proximity of the saleyard, provided the final reason for selecting the Wodonga livestock selling complex as the subject for short-run cost estimation.

4.1.2 Data Issues and the Short-Run Cost Construct

The accounting data used to estimate short-run costs is divided into operating expenditure and non-operating expenditure by the City of Wodonga. While it may be intuitively appealing to assume that operating expenditures are synonymous with short-run economic costs, closer inspection reveals that many of the costs in this category are derived by accounting convention rather than through variations in output and resulting changes in factor productivity. For example, the use of straight-line depreciation techniques seldom reflects the depreciation in use which warrants inclusion in an analysis of economic costs. Borrowing from the engineering approach to cost estimation, it is apparent that the variable inputs in the process of livestock selling include labour, electricity, water, repairs to existing saleyard facilities, depreciation of those facilities, and some other minor physical inputs. The fixed input is assumed to be the saleyard complex itself. If short-run economic cost functions are to be estimated cost variations associated with inputs must be isolated and mapped against variations in output. A number of problems arose in isolating these variations.

Unfortunately, the accounting data held by the City of Wodonga generally does not specify wages paid to those employed within the saleyard facility. Wages associated with the saleyard are included within the two accounting items, 'maintenance charge' and 'administration charge to the city'. Discussion with those responsible for such accounts suggested that a significant proportion of both of these charges related directly to labour costs. Closer inspection of details obtained from other saleyards suggested that approximately 76% of the 'administration charge' and 'maintenance charge' aggregates could be regarded as wages. Since there was inconsistency in the distribution of costs between these two accounting items, it was appropriate to sum both items and isolate that component of the aggregate that could be expected to represent wages.

Isolating the wages component of costs which relate to saleyard throughput is further complicated by the inclusion of non-earnings labour costs or 'on-costs' within the council data. Labour costs include both earnings and non-earnings costs such as superannuation, workers compensation and payroll tax. The significance of the latter has increased throughout Australia in recent years with nominal non-earnings costs increasing by 63% between 1986-87 and 1993-94. Nominal earnings increased by only 41% over the same time period (ABS, 1996). Notable events in this period included the introduction of the superannuation guarantee charge in 1992 and the national wage case in 1986 which awarded a 3% superannuation 'wage rise'. Moreover, while such adjustments to non-earnings labour costs impact significantly on the accounting costs recorded by council they have no relationship to the economic costs which we seek to uncover by this study. A further adjustment to labour costs was felt necessary to disclose the cost throughput relationship.

The ABS collects triennial data showing movements in nominal labour costs. Unfortunately, this data does not extend over the complete time series of saleyard data with the first release relating to labour costs in 1986-87 and the latest issue relating to costs in 1993-94. It was therefore assumed that the distribution of labour costs between earnings and non-earnings for years prior to the first release was similar to that in 1986-87. Similarly, for years after the latest release it was assumed that the proportion of labour costs attributed to non-earnings was similar to that in 1993-94. In summary, wages were derived from accounting data by isolating that component of the aggregated administration and maintenance charges that was likely to represent labour and removing estimated non-earnings labour costs.

An additional problem arises with respect to labour inputs from the shared responsibility of tasks between municipal employees and selling agents. Agents or their employees are largely responsible for the delivery of livestock to saleyards, penning and drafting of livestock and, in some instances, movement of livestock within the saleyard complex. Increased livestock throughput may therefore impose additional labour costs on agents and remain undetected in those labour costs borne by the Council. This will be most significant where municipal employees have workloads with excess capacity or the flexibility to reschedule other tasks during periods of increased throughput. It is not possible to test the extent to which fluctuations in wages costs are distorted by these factors. However, it is assumed that these influences are only minor.

The cost of electricity and water poses fewer problems with accounting records providing nominal costs for power and water. However, it is worth noting that variations in these costs may also be subject to some variations outside those usually consistent with economic costs. The rating and pricing of water may fluctuate with changes in government policy rather than changes in usage alone. For example, the imposition of a price ceiling by the Victorian government on water charges applied by the recently created water corporations may distort the cost data associated with this input. Similarly, changes to the rating of community assets during the period of analysis may produce other distortions. However, such influences do not appear to have been significant over the period of this study in Wodonga.

The accounting records of the City of Wodonga also provide nominal data on the cost of repairs and maintenance at the saleyard facility. While it has been assumed that these costs relate directly to the usage of the saleyard facility, and therefore the throughput of livestock, it is also possible that repair and maintenance costs are, in part, a function of the age of the selling complex. This can be controlled to some extent by including the age of the selling complex as an additional explanatory variable when regressing costs against output. Other problems arise from improvements or alterations to the saleyard facility which have been included for accounting convention within this item. Clearly, where such inclusions are both frequent and significant it would be necessary to exclude this item from short-run cost estimation.

Depreciation of the saleyard facility through ongoing use is arguably one of the most troublesome costs in statistical estimation. Accounting convention dictates the method of calculating the depreciation of assets or infrastructure. Often the choice between straight-line and diminishing-balance methodology is based upon tax incentives rather than on economic costs associated with the use and subsequent deterioration of that asset. Recorded depreciation expenses for the Wodonga livestock selling complex reflects the usual distortions created by accounting convention and also altered methodologies over time. An alternative to the conventional straight-line and diminishing-balance methodologies is presented by the Rushton group of valuers (Orton Agribusiness 1993, p. 24). The Rushton depreciation model was developed by the Rushton valuers group through an analysis of market prices for assets and other depreciation models applied by the Taxation Department (per comm. Frank Julier, Rushton Valuers, 1997). While it is preferable to apply such models only after extensive analysis of assets by representatives of the valuers group, it has been suggested that this model provides a "...more realistic saleyard present value [than conventional techniques]" (Orton Agribusiness 1993 p. 24). Moreover, recent inspection of the Wodonga selling complex by representatives from the Rushton group and the similarity of results reported by these representatives and Orton Agribusiness (1993) support the view that the Rushton model may be the most appropriate method for estimating the economic cost of saleyard depreciation.

While the Rushton model has specific appeal in this instance it is worth noting the possibility exists for double-counting the economic costs associated with depreciation in use. It was observed earlier that the explicit costs captured by this cost estimation include amounts paid for minor repairs and maintenance. The available data does not detail the extent of these 'repairs' which, if extensive, would violate one of the contingent assumptions of the short-run cost construct. Moreover, such repairs have the potential to offset some of the costs attribute to depreciation in use. Excessive expenditure involved in maintaining a saleyard venue is likely to reduce the rate of depreciation in use. Unfortunately, blanket application of the Rushton model does not have the flexibility to accommodate such issues and may result in an over-estimation of the effects of depreciation.

To apply the Rushton depreciation model it is necessary to first establish the replacement cost of the saleyard assets. Using an engineering approach, Orton Agribusiness (1993) examined the replacement cost of saleyards in Victoria. Detailed analysis was conducted of the infrastructure requirements of two saleyards of varying capacities, including the Wodonga saleyard. The valuation was exhaustive and covered all infrastructure requirements for both cattle and sheep. This resulted in a model for estimating the replacement cost based on the saleyard area devoted to the throughput of the different species of livestock. This model also has appeal for its ability to provide data on other saleyards used in long-run analysis.

Accounting costs generally include only explicit costs of production. An analysis of economic costs would be incomplete if the opportunity cost of some inputs, including the implicit cost of capital, was overlooked. Moreover, given the magnitude of the estimated replacement and present value of some of these complexes, the opportunity cost of capital is one of the most significant costs in this analysis. To estimate this cost, it is necessary to establish both the value of capital currently employed by the saleyard and the benefits accrued from the alternative use of that capital. The annual value of capital was established by using the Rushton depreciation model to transform the 1993 Orton estimates of replacement cost. CPI data for Melbourne were then used to develop estimated capital values in current year prices. It was assumed that the return from the alternative use of this capital was equivalent to the return on 90 day bank bills in June of the current year. The forgone nominal interest was therefore expected to reflect the opportunity cost of capital for each year in the time series data.

The theoretical short-run cost construct requires that input prices be held constant over the period of analysis. Generally there are two approaches to controlling for price variations. Firstly, all data can be adjusted for price movements prior to the estimation process. Where detailed information on specific input prices is unavailable, use of some aggregate price deflator, such as the CPI, is required. Alternatively, price movements can be included as separate explanatory variables within the regression analysis thus isolating their impact from those cost fluctuations attributable to changes in throughput. In this case the latter technique was adopted allowing for the inclusion of information on wage movements and prices in general.

Wage movements were estimated using the ABS index of weekly award rates of pay since few municipal workers in saleyards have access to above award payments. Moreover, the index for male weekly award rates of pay was employed due to the clear gender bias in saleyard employment. Price movements in other inputs were assumed to be reflected in movements in the CPI. Since regional CPI measures are unavailable, data for Melbourne were used for these purposes. Any error generated by applying metropolitan price adjustments to regional areas is likely to be only minor.

Statistical cost estimation rests not only on distinguishing those costs which relate directly to output, but also tracking those costs to the appropriate output level. This is likely to be a problem where the accounting data either lag or lead productive activity. In almost all cases, the accounting data used in this analysis were estimated actual expenditure gleaned from the subsequent years budget. Since these are annual budgets, it was assumed that lead or lag problems are largely minimised. However, the absence of estimated actual expenditures for 1986-87 and 1995-96 necessitated the use of budget estimates for those years. A further complicating issue relates to the different accounting periods used to collect data on costs of the Wodonga selling complex and the output data supplied by the Municipal Saleyards Association [MSA]. The MSA measures livestock throughput on an annual basis as at the 30th September each year. The Council's accounting records are based on a financial year ending on the 30th June each year. Inspection of livestock throughput for the last two years ending June 30 revealed only minor differences to the data available from the two sources. The MSA data covers all saleyards examined in this study and it was felt that these minor differences in recorded output would not significantly distort the estimated cost functions and this was selected as the data source for outputs.

While the accounting procedures employed by the City of Wodonga showed only minor alterations during and after the amalgamation of Victorian councils, there have been a number of amendments and alterations to the accounting procedures since fiscal year 1980-81. The effect of these changes has been to both shift and redefine a number of items within the accounts held for the saleyard complex. Moreover, changes to personnel within local government make it impossible to totally expose only those variations in costs which are consistent with the theoretical short-run cost function described in chapter two. Wherever possible, accounting costs which are likely to distort the analysis have been omitted. For example, interest repayments and allowances for bad debts have been excluded to provide a clearer estimate of the impact of throughput on cost. However, it is important to remain mindful of the limitations inherent in both the size and accuracy of this data set.

One final point relates to the range of output within these data. Output, as defined by cattle throughput, varies by approximately 60 000 head over the period 1980-81 to 1995-96. However, annual variations are generally less pronounced. This factor combined with the probable inability of management to respond rapidly to variations in output, may make it difficult to discern the hypothesised relationship between short-run costs and output.

4.1.3 Results of Short-Run Cost Estimation

The appropriate functional forms for short-run cost estimation were discussed in section 2.2.2. Moreover, total costs are estimated in preference to average costs to minimise the potential for collinearity. All statistical estimation was conducted using 'Statistical Package for the Social Sciences' [SPSS for Windows]. The cubic function described by equation (2.13) was favoured for its ability to represent initial increasing returns to the factor followed by momentary constant returns before the onset of diminishing returns:

$$STC = F + gQ + hQ^2 + iQ^3 \qquad (2.13)$$

Since it is desirable to control for fluctuations in cost which derive from movements in input prices, these are also included in the regression model. Similarly, control for the effect of the throughput of other animal species is achieved by inclusion of sheep throughput as a variable within the estimated model. The resulting model is presented in Table 4.1.

Table 4.1: Estimated Short-Run Costs for Wodonga Saleyard, 1980-81 to 1995-96.

Variable	Coefficient	t value
Cattle	-73.48	-2.927
(Cattle)^2	-296.06	-2.361
(Cattle)^3	5.1E-10	2.787
Sheep	3.14	3.902
Wage Movement	-11001.97	-0.778
CPI Movement	13208.97	1.380
Constant	10392457.68	2.783

*Adjusted R^2 0.63

A priori, we would expect that total short-run costs would rise as output increased. However, the size and sign of the cattle coefficient implies that total short-run costs decline over the feasible range of output for this saleyard. Moreover, given that the cattle coefficients are all significant at the 5% level the model predicts falling rather than rising total costs with increments in cattle throughput. Such a prediction is inconsistent with economic theory and implies that further analysis of short-run break-even throughput and profitability is fruitless. The signs of the coefficient relating to both cattle and wage movements also suggest the existence of some collinearity within the model. While removing variables to reduce collinearity is desirable, given the small data set upon which this model is based, only marginal improvement in the models predictive capacity is likely. The problems confronted in constructing this short-run cost model derive largely from the non-availability of data that conforms to the rigorous constraints of the theoretical short-run construct. Specifically, restricting the data set to exclude changes in plant size reduces the possibility of robust statistical estimation. Non-parametric estimation could be applied to this model. However, an alternative approach may be to reserve analysis of individual saleyards until modelling of the larger data set available for long-run analysis is completed. We follow this procedure in the present context.

4.2 Estimating Long-Run Costs

The sample data for long-run cost estimation is not constrained by the requirement of constant saleyard size. Moreover, the focus of long-run cost estimation is often to determine the size or scale of plant which is capable of producing output at lowest unit cost.

4.2.1 Sampling Frame for Long-Run Cost Estimation

The nature of the long-run cost construct lends itself to estimation with cross-sectional data. Using cross-sectional data for a single year would minimise the influences of time-sensitive variables such as climatic or seasonal factors. However, inherent in the control of such variations is a reduction in sample size.

The MSA reports the throughput of thirty-one Victorian saleyards. Ideally, if all saleyards provided cost and throughput data for a 'normal' year it would be possible to use this data to model the long-run costs of saleyard complexes. However, this limits the data set to a maximum of thirty-one observations. There are four other problems which arise from this approach. Firstly, not all saleyards keep separate accounting data of costs, let alone data relating to economic costs. As evident from the attempt to estimate the short-run costs of a single saleyard, the frugal nature of this data imposes severe restrictions on any estimation process. Secondly, defining a 'normal' production year across all saleyards may not be possible. While Victoria is relatively small in geographic area, there may be considerable climatic and seasonal variations within the State. 'Normal' seasons in the Gippsland districts may coincide with 'abnormal' seasons in the Western districts. Thirdly, using data from all Victorian saleyards may distort the focus of the present study. The purpose of this study has been to unravel the relationship between cattle throughput and costs in municipal saleyards. Some Victorian saleyards focus largely on throughput of other animal species, and cattle throughput is regarded as a secondary activity. Finally, the infrastructure requirements contingent upon saleyards where cattle are a primary throughput differ significantly from those saleyards dominated by other animal species. Saleyards without liveweight scales cannot easily be compared with those yards which operate such facilities.

To overcome these problems data was drawn from selected Victorian saleyards where cattle throughput was significant. To provide a data set of sufficient size to facilitate robust estimation, it was necessary to broaden the time period from which data was selected. It is acknowledged that extending the data set over a number of years adds other non-cost variability to the data. However, it was felt that the addition to the size of the data set would compensate for this additional 'noise'. Orton Agribusiness (1993) reported incomplete accounting data for eight Victorian saleyards from 1987 to 1992. All venues had significant cattle throughput and cattle breed was not sufficiently different between districts to effect the activities of the saleyards. By completing and extending the accounting information for these saleyards it was possible to compile a data set suitable for long-run cost estimation.

The data set comprised observations from Wodonga, Dandenong, Euroa, Sale, Colac, Camperdown, Bendigo and Benalla. The data relating to each saleyard varied both in its detail and availability. Some saleyards had complete and continuous records with no discernable change to accounting practices or format. Others only had data for selected years with variations in accounting convention complicating the hypothesised relationship between output and cost. All saleyards were requested to provide current data to extend the time series to 1995-96. Three saleyards did not provide this data, one citing restrictions imposed by the contracting-out of saleyard operations. The resultant data set comprised 77 observations across the eight selling complexes.

Detailed data was also sought from the Bendigo saleyard to verify the methodology used to estimate wages from the available accounting data. While the data relating to the Bendigo saleyard exhibited many of the problems of varied accounting practice, detailed accounts from the 1980's provided valuable insight to the composition of some of the larger accounting aggregates. Moreover, this information was consistent with the data collected from the Wodonga selling complex in that approximately 76% of the aggregated maintenance and administration charges could be attributed to labour costs. The methodology described in section 4.1.2 was applied to all eight saleyards in an effort to derive data which was consistent with economic rather than accounting practice. In summary, wages were estimated by isolating 76% of the aggregated administration and maintenance charges after which non-earnings costs were removed. Minor maintenance, power and water costs were taken directly from accounting data where it was available. The cost of capital was derived by first estimating the replacement cost of each saleyard and applying a Rushton depreciation schedule based on the average age of the saleyard infrastructure. The present values of each saleyard was then transformed to current year prices for the extent of the time series data. The cost of capital was then determined in current prices by assuming the opportunity cost was equivalent to the return on 90 day bank bills in June of each year. Movements in the prices of inputs were assumed to be reflected in an index of weekly male award wages and the CPI for Melbourne using 1980-81 as the base year.

Problems were again encountered in transforming accounting data into economic data. Records were often incomplete or inconsistent for specific saleyards, and accounting practices and conventions differed widely between local governments. Variations in taxonomy used to define specific cost items made it difficult to trace movements in costs which could be attributed solely to variations in livestock throughput. Data collected by Orton (1993) was not always consistent with the current accounting records held by some municipalities. Adjustments to some accounting items were made to reflect prevailing records. Similarly, amendments to some data were necessary to reflect changes to the financial year used by some councils. All costs not consistent with economic costs, such as advertising and subscriptions to the MSA, were omitted. Despite these precautions, it was not possible to completely cleanse the data of all variability inconsistent with economic constructs. However, it was felt that the size of the data set was sufficient to provide robust estimation of movements in economic costs.

4.2.2 Results of Long-Run Cost Estimation

Chapter two identified three functional forms which warrant testing against the long-run cost construct:

$$lnC = lnA + 1/v\ lnQ + \alpha/v\ ln\ p_1 + \beta/v\ ln\ p_2 \qquad (2.17)$$

$$C = a + bQ + cQ^2 + d_i X_i \tag{2.18}$$

$$\ln C = \ln A + 1/v \ln Q + d_i X_i \tag{2.19}$$

The transformation developed by Nerlove (1963), equation (2.17), allows for the inclusion of input prices as explanatory variables and the elasticity of cost with respect to output is given by the value of *1/v*. Unfortunately, this transformation does not allow for the inclusion of other explanatory variables, such as the throughput of alternative animal species or the age of the saleyard. This limitation does not extend to the quadratic form found in equation (2.18). In this case a vector of non-size explanatory variables (X_i) is included in the transformation. Similarly, the logarithmic form presented by Vitaliano (1987) can be used to incorporate non-size explanatory variables. Moreover, this logarithmic transformation accommodates the possibility of an L-shaped LAC function in saleyard selling.

All three functional forms were modelled using 'Statistical Package for the Social Sciences' [SPSS for Windows] with listwise deletion of any missing data. Results are presented in Table 4.2.

Table 4.2: Alternative Models of Long-Run Costs

Variable	Equation (2.17)	Equation (2.18)	Equation (2.19)
***ln* Cattle**	0.742 (9.201)		0.554 (8.34)
Cattle		3.141 (2.122)	
Cattle^2		3.043E-06 (0.535)	
***ln* Wage Movements**	-1.030 (-.210)		
***ln* CPI Movements**	-0.529 (-.0156)		
Wage Movements		16028.296 (2.126)	-0.010 (-0.545)
CPI Movements		-8266.582 (-1.816)	0.011 (0.989)
Sheep Throughput		0.323 (5.560)	1.046E-06 (7.608)
Age		-8628.714 (-3.106)	-0.038 (-6.243)
***ln* Constant**	1526.908 (0.964)		675.083 (5.484)
Constant		-834201.605 (-2.124)	
Adjusted R^2	0.68	0.88	0.85

**t-values in parentheses*

All models produced rising total costs with increased livestock throughput though each model presented specific weaknesses. The logarithmic form developed by Nerlove (1963) produced only one variable significant at the 5% level, the natural logarithm of cattle throughput. Moreover, the collinearity between the input price variables severely restricts the application of this model to further analysis. The alternative logarithmic form in equation (2.19) had improved predictive capacities and all variables were significant at the 5% level except the input price variables. Exclusion of one of these variables to remove collinearity would improve this model, though the calculation of the grand constant was troublesome. Specifically, the grand constant was implausibly low and inconsistent with the engineering data on the operation of saleyards. The quadratic form produced the most robust estimates of the three models. All explanatory variables were significant at the 5% level, except the '$cattle^2$' term. There were once again problems with the collinearity between the input price variables.

To establish the extent of collinearity eigenvalues and condition indexes were calculated for all explanatory variables in the quadratic model. These are presented in appendix A. On the basis of these values the variable relating to CPI movements was excluded from the model to adjust for collinearity. The collinearity between the two cattle variables was anticipated and the '$cattle^2$' term was retained despite its relatively low statistical significance. Retention of this term was justified on the basis of the predicted behaviour of the economic constructs. The adjusted quadratic model appears in Table 4.3.

Table 4.3: Adjusted Quadratic Long-Run Costs Model

Variable	Coefficient	t- value
Cattle	3.382	2.246
(Cattle)^2	1.707E-06	0.296
Sheep	0.334	5.653
Wage Movement	2481.418	2.222
Age	-9451	-3.376
Constant	-197386.935	-1.094

*Adjusted R^2 0.87

All variables other than the 'cattle^2' term were significant at the 5% level. The model produces a U-shaped LAC function though diseconomies occur only at relatively high levels of throughput. Moreover, increased throughput would yield economies to all but the largest saleyards. This is consistent with the logarithmic models which both revealed economies of scale and/or size. Detailed discussion of these issues is reserved for section 4.5.

4.3 Estimating Short-Run Revenues

While the estimation of short-run costs was hampered by the absence of a broad sampling frame, revenues from the same data were also estimated, largely in the interests of completeness.

4.3.1 Sampling Frame and Data Issues

Data on the Wodonga selling complex was used to derive a revenue function. It was originally intended that this data would provide the foundations for analysing the short-run profitability of saleyard venues. Establishing the revenues associated with the saleyard complex was generally less taxing than the disclosure of economic costs. Again the data set was restricted to the period 1980-81 to 1995-96 to control for major changes in the operation of the Wodonga facility. The data set was complete for this period with the main sources of revenue being fees imposed on selling agents, yard dues and weighing charges paid by vendors.

Other revenues were excluded from the analysis. Interest earned on investments was omitted since this was not strictly related to saleyard throughput. Rents charged on canteen and office facilities were similarly excluded. While it was possible to argue that receipts from truck wash facilities and rents from holding paddocks are compatible with the economic revenue construct these items were removed to retain consistency within the broader data set used for long-run estimation.

4.3.2 Results of Short-Run Revenues Estimation

A linear function was assumed adequate to represent saleyard revenues. Throughput of other animal species was again included as an explanatory variable to control for variations outside those created by cattle throughput. Since revenues were presented in nominal form, CPI data for Melbourne was included as a control for general price movements. The resulting model is presented in Table 4.4.

Table 4.4: Linear Revenue Model of Wodonga Saleyards

Variable	Coefficient	t- value
Cattle	1.139	2.168
Sheep	0.478	2.118
CPI Movement	4387.347	11.296
Constant	-385245.460	-2.646

*Adjusted R^2 0.96

All variables are significant at the 5% level, except sheep throughput which is significant at the 10% level. The sign of variables confirms the *a priori* view that increased livestock throughput generates increased revenues with unit revenue from cattle exceeding sheep by approximately threefold. While the sign of the constant appears contrary to the *a priori* expectations detailed in section 2.4.2, subsuming the sheep and CPI coefficients into a grand constant produces a positive intercept. Despite the apparently robust nature of the model, its use is again restricted by the narrow sample set on which it is based. Moreover, the inability to adequately model short-run costs prevents further application of this model.

4.4 Estimating Long-Run Revenues

The data set used for long-run cost estimation was sufficiently large to generate models suitable for estimating the minimum efficient scale of livestock selling facilities. However, to extend this analysis to profitability requires an estimate of revenues over a similar range of output. Since it would be methodologically inconsistent to apply the Wodonga revenue model, this larger data set was employed to estimate the appropriate revenue function.

4.4.1 Sampling Frame and Data Issues

Again the sampling frame used was the data assembled on eight Victorian saleyards. Recorded revenues had notably fewer inconsistencies and variations in accounting practice across all saleyards. Agents fees, yard dues and weighing charges were again isolated as the major sources of revenue, since not all records consistently enumerated receipts from other activities. Transfers from other council funds were omitted along with truck-wash receipts, interest earnings and rents.

4.4.2 Results of Long-Run Revenues Estimation

The methodology used to estimate the revenue function for the Wodonga saleyard was also applied here ie. a linear function was estimated with CPI movements and throughput of sheep included to control for non-size variations. The resulting model is presented in Table 4.5.

Table 4.5: Linear Revenue Model for all Saleyards

Variable	Coefficient	t- value
Cattle	3.687	17.953
Sheep	0.306	5.723
CPI Movement	2886.675	5.964
Constant	-571409.030	-5.281

*Adjusted R^2 0.85

All variables in the model were significant at the 5% level and have signs which meet with *a priori* expectations. The relatively robust nature of this model lends itself to inclusion with earlier long-run cost estimates in an analysis of saleyard profitability.

4.5 Management Issues and Saleyard Efficiency

Constraining saleyard revenues and costs to neo-classical economic constructs permits an assessment of the internal economic characteristic of this activity. Moreover, the results of this analysis can be carried to a broader cost benefit framework for the inclusion of external economic considerations.

4.5.1 Break-Even and Profitability

One of the broader goals of this research has been to estimate the level of livestock throughput which leaves local government revenues neutral. As we have seen, the Saleyard Working Party (1986) proposed a rationalisation of saleyard selling which would have resulted in the closure of many smaller selling complexes. The justification for this proposed rationalisation was the perceived excess capacity in Victorian saleyards generally, and the inefficiencies associated with smaller selling venues in particular (Saleyard Working Party 1986, p. 1) . Moreover, during the course of this research anecdotal evidence has been gathered from those involved in the livestock industry that suggests smaller saleyards continue to operate as a direct result of government failure. These views can now be tested against the cost and revenue models developed in this chapter.

The adjusted quadratic long-run cost function described in Table 4.3 was selected for its ability to adequately comply with economic cost constructs and produce robust statistical predictions. Similarly, the statistical diagnostics of the revenue function described in Table 4.5 favour its inclusion in this analysis. Since this study has restricted throughput to the single output cattle, other explanatory variables in these models are subsumed into a grand constant. This constant is derived by multiplying the mean values of variables by their respective coefficients and summing with the estimated constant. The resulting break-even levels of cattle throughput are 12 176 head and 166 609 head respectively. Cattle throughput between these levels of output is expected to generate positive economic profits. Profit maximisation based upon these cost and revenue models is estimated at 89 392 head.

A number of important caveats apply to these estimated levels of throughput. Firstly, the derivation of the grand constant rests heavily on the mean values of other explanatory variables within the models. Of particular significance is the mean value of sheep throughput generated by the data set. The mean throughput of sheep was substantially influenced by the activities of the Bendigo saleyard which may be regarded as an outlier in this respect. Removing the Bendigo saleyard would substantially reduce the mean value of sheep throughput and therefore displace the intercept term of both the generalised revenue and cost functions. Clearly, saleyards with smaller volumes of sheep throughput would require different levels of cattle throughput to break-even or generate profits. Moreover, the disparity between the sheep coefficient in the cost and revenue functions suggests a broadening of the profitable range of output at lower levels of sheep throughput. Other variables used to generate the grand constant are of less concern since they exhibiting less variability.

The magnitude and sign of the age variable in the cost function also suggests caution in the application of these results. The coefficient for this variable indicates that total saleyard costs can be expected to decline by over $9 000 for each year of the saleyards operation. While these results are consistent with the theory of learning curves, it is more likely that the data set has been influenced by the methodology used to calculate depreciation in use. Acceptance of these estimates of profitability are therefore contingent upon an endorsement of the depreciation methodology as an accurate representation of livestock saleyards.

Similarly, the methodology used to derive the opportunity cost of capital has a significant impact on the 'age' coefficient in the cost function and implicitly affects the estimated output levels which generate saleyard profitability. We noted earlier that the nominal return on 90 day bank bills was assumed to represent the opportunity cost of nominal capital. Price movements were originally controlled by including CPI movements as an explanatory variable. However, removal of the CPI variable to address collinearity within the model generally overstates the real return on capital. More specifically, wage movements are left as the sole explanatory variable to control for movements in input prices. Since award wages have grown at a slower rate than prices, this may overstate the real interest that would accrue to 90 day bank bills. Moreover, the return on 90 day bank bills may be inappropriate to government infrastructure projects such as saleyards. An acceptance of lower returns to capital would displace the cost curve downwards extending the level of output which generates profits.

A further consideration is the bias which may arise from the uneven representation of saleyards within the data set. Non-response by Colac, Benalla and Euroa leaves the observations from these saleyards restricted to those sourced from Orton (1993). Specifically, data on these saleyards does not extend beyond 1992 and the relatively limited number of observations from these complexes may have produced some bias within the sampling frame.

These caveats aside, the estimated levels of profitability and break-even boundaries have significant implications for the operation of smaller saleyards. Clearly, low levels of livestock throughput are likely to place an impost on the local government that sponsors these activities. A review of MSA data for 1996 would suggest that at least nine saleyards have insufficient livestock throughput to operate with economic profits. The livestock throughput of at least four other saleyards may also be regarded as marginal.

4.5.2 Minimum Efficient Scale and Returns to Scale

Minimum efficient scale [MES] refers to the level of output which minimises unit costs. Transforming the quadratic LTC function to quadratic form LAC indicates that the level of throughput necessary to achieve minimum unit cost is 218,802 head. Inspection of livestock throughput data shows that in 1996 only the largest saleyard [Wodonga] approached this level of throughput with 213,071 head. A mean throughput of 93,252 from the data set suggests that the 'average saleyard' fails to operate at minimum unit cost. Since total Victorian saleyard throughput was 1.3 million cattle in 1996, it may be suggested that the saleyard industry would achieve minimum unit costs through the operation of only six large saleyard venues. Such conclusions should be treated cautiously for a number of reasons.

Firstly, the estimated level of MES is heavily influenced by the functional form chosen to represent the data. The logarithmic transformations presented in Table 4.3 generate output coefficients [$1/v$] of 0.74 and 0.55 for equations (2.17) and (2.19) respectively. These coefficients suggest economies of scale for all feasible ranges of output and are therefore consistent with L-shaped rather than U-shaped LAC functions. A MES of approximately 210,000 head of cattle may be a reflection of the transformation selected to represent the data rather than conclusive evidence of diseconomies beyond this level of output.

Secondly, further inspection of unit costs suggests that economies are more significant than potential diseconomies. Using the quadratic cost formation results in average unit cost for 10,000 head of $11.57 expressed in 1981 dollars. As cattle throughput increases to 50,000 head, unit costs are more than halved to $5.10. Further expansion of throughput to MES results in a relatively modest decline in unit costs to $4.13. Continued expansion to 300,000 head generates a rise in unit costs of only $0.04. Clearly, potential economies are greatest for saleyards with very low levels of throughput. Moreover, it is these saleyards which operate at greatest unit cost and impose economic losses upon the municipal governments responsible for their activities. Alternatively, saleyards with throughput of 100,000 head provide only a minor cost disadvantage to those saleyards operating at MES.

The discussion up to this point has focussed solely on saleyards which operate liveweight selling facilities with similar breeds. During the course of this research anecdotal evidence was encountered on saleyards who develop 'niche' markets in store cattle. It is argued by some that the saleyard selling industry can accommodate venues that rely more on distinguishing the quality of livestock than livestock throughput per se. Insufficient evidence is available to confirm or criticise these views.

4.5.3 Efficient Pricing

In section 4.5.1 a level of livestock throughput was identified which produces break-even for municipal saleyards in Victoria. Implicit in this analysis is the view that throughput short of break-even can only be justified if the resulting impost on the municipality is compensated by other external benefits. Before moving to an analysis of these external benefits in chapter six, it is necessary to consider the role of revenue and pricing in achieving break-even throughput.

Clearly, the continued viability of all Victorian saleyards is not solely contingent on achieving MES, particularly given the modest gains in unit cost above throughput of 100,000 head. Some small saleyards may achieve break-even by simply setting prices which equate or exceed average cost. It would be spurious to suggest that such saleyards should perform their activities efficiently or deserve the support of the local governments. In a partial equilibrium framework efficient pricing implies the equation of price and marginal cost. In its classic Pigovian formulation, this pricing structure results in economic efficiency if no external costs and benefits are present and any attempted reallocation of resources would be sub-optimal. It is therefore desirable to extend the analysis of this industry beyond break-even and MES throughput to consider any disparity between pricing and marginal cost.

In chapter two, revenue functions were described with emphasis on the unique features of saleyard revenue. It was noted that the average revenue function was likely to be L-shaped since the two main sources of revenue are charges on livestock agents, which are unrelated to throughput, and charges to vendors which are positively related to throughput. The anticipated result was very high average revenues for the first units of cattle throughput declining to some smaller amount reflecting the unit charges imposed on vendors. Given the nature of this function there are constraints upon using traditional techniques to assess the appropriate 'price' of different levels of throughput.

The high prices which result at low levels of output may reflect the charges imposed on livestock selling agents which are embedded in the intercept term. However, choosing only the charges imposed on vendors would clearly underestimate the 'price'. This is supported by the practice of selling agents transferring agent's fees imposed by the saleyard to the vendor via their commissions. It was therefore felt appropriate to cautiously use the average revenue function derived from the model described in Table 4.5. Again all figures are expressed in 1980-81 dollars.

The results further support the view that saleyards with small throughput of livestock impose welfare losses on communities. An investigation of the lower break-even throughput produced estimated marginal cost of \$3.42 per unit of throughput with an average revenue or price of \$10.11. However, at MES the marginal cost of \$4.13 exceeds the price of \$4.04. The throughput which equates price and marginal cost is 202.558 head, just short of MES. The disparity between the marginal cost and price at the lower break-even throughput may suggest that saleyards with this level of throughput break even by charging economically inefficient prices to their users. Alternatively, this result may indicate the embedding of agents fees in the intercept term of the average revenue function and the importance of this intercept term in determining the level of break-even throughput.

Either interpretation is less than encouraging for saleyards with low levels of livestock throughput. If the lower break-even of approximately 12,000 head of cattle occurs because of actual management practices that create inefficient pricing, it may be in the interest of the community to review and modify the use of these facilities. Moreover, these pricing practices have significant implications for efficient pricing in the broader livestock industries served by saleyards. If the lower limit of break-even has been influenced by the 'unrealistically high intercept' of the average revenue function then modification of the revenue data may be appropriate. However, downward adjustment of this intercept term implies that the lower break-even point occurs at an even higher level of throughput. As a result, marginal saleyards identified in the earlier analysis would become even more unprofitable. Therefore the continued operation of these saleyards could only be justified on efficiency grounds if the saleyard facility generated external benefits or reduced external costs to the community.

4.6 Summary

Statistical cost and revenue functions were estimated using data drawn from local governments. The short-run economic construct requires that at least one input be held constant. Thus the short-run lends itself to the modelling of time series data relating to a single saleyard. Unfortunately, data on saleyards is generally recorded annually requiring a long time period to establish a data set of suitable size. In this case data were collected on the operation of the Wodonga saleyard between 1980-81 and 1995-96. Attempts were made to model this data using transformations consistent with economic theory. However, the resulting frugal data set lacked the statistical veracity to produce robust estimation of these functions.

Since the long-run construct allows for variability of all inputs it was possible to extend the data set to include other saleyards than Wodonga. Ideally cross-sectional data could have been used for the modelling of long-run costs and revenue functions. However, extending the data set to all Victorian saleyards introduces other sources of variability. Accordingly, to achieve a sample size suitable for statistical estimation a combination of time-series and cross-sectional data was assembled. The data was then transformed to closely comply with the economic constructs under investigation. Innovative techniques were employed to adapt accounting data which varied in its presentation and completeness. The resulting data set traces the economic relationship between costs, revenue and output in Victorian saleyards.

Robust long-run models were derived from these data which conform to theoretical constructs. More specifically, a quadratic LTC function and linear total revenue function provided the basis for analysing the management and efficiency of saleyards. Logarithmic functions were also tested which generally supported the analysis developed employing other functional forms. This analysis suggests that saleyard with throughput of less than 12, 000 head operate at an economic loss. Moreover, closer inspection of MES and revenue issues indicates that saleyards with only slightly greater throughput may also place a burden on the communities that provide these facilities. The extent of this impost may be tempered by other external benefits to be examined in chapter five.