CHAPTER 5

CAPITAL: I - LAND AND IMPROVEMENTS

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5.1 Introduction

The estimates of the land and improvements components of capital are considered together in this chapter for two reasons. First, they are closely related components; in many cases, improvements cannot be physically separated from land. Second, the estimates are at least partially derived from the same basic data source, land valuation data.

In spite of this, separate consideration is given to the land and improvements components. The definition of land and improvements is determined by the valuation concepts. Land corresponds to the concept of unimproved value[2] which is in essence the land in its original condition. The difference between unimproved value and improved value corresponds to the value of improvements. Improved value as it is generally employed approximates the market value of the property including fixtures. Thus, the improvements will consist of land clearing, fencing, watering and irrigating, structures such as buildings, and soil conservation.

It is the improvements type investments that largely fall into the on-farm produced category that were discussed in Chapter 2. Most of these investments must be carried out on site, and frequently involve the use of on-farm resources and the purchase of required materials. The problem is adequately summed up by Campbell [11, p.123] when rejecting the belief that these improvements type investments were

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1 This Chapter is an amended version of a paper presented to the Australian Agricultural Economics Society Conference, Perth, 1974.

2 Scott [23] quotes the N.S.W. definition which is similar to those used in other States. "...the capital sum which the fee simple of the land might be expected to realise if offered for sale on such reasonable terms and conditions as a bona fide seller would require, assuming that the improvements if any thereon or appertaining thereto, and made or acquired by the owner or his predecessor in title, had not been made".

relatively insignificant.

> "In the first place, recent agricultural developments have probably altered the order of magnitude of this category of investment considerably. In the second place, actual outlays by farmers on equipment and supplies for work of this kind may give little clue as to the net addition to farm capital resulting from such work. The internal farm labour component in such capital works (and also farm buildings to a lesser extent) may be quite considerable. Added to this is the difficulty, experienced even at the individual farm level, of distinguishing clearly between current operating expenses and expenditure of a capital nature. In short, the estimates of aggregate private investment ... underestimate the extent of gross capital formation in agriculture. Despite agriculture's increasing dependence on the market for capital equipment and materials, it still remains true that a sizeable amount of the developmental work is done by the farm labour force, as is patently true under pioneering conditions. The counterpart of this in secondary industry is probably negligible in the aggregate."

All that remains to be added to the quote from Campbell is that on-farm capital, primarily plant and machinery, play an important role in such capital formation as well as on-farm labour, particularly in recent years.

Thus, the problem of substantial underestimation in official statistics of capital formation on farms has been recognised, but rarely investigated. There has been a tendency to recognise the problem as Campbell did, but then to fall back on official estimates of investment which tend to include depreciable expenditures only. Gutman [16] has produced the only estimate of rural capital and investment which includes on-farm produced capital investment. This involves compiling estimates of improvements to land and Gutman did this for the years 1920-21 to 1945-46. His estimates were extended to 1966-67 by Wilson [27] using valuation data compiled by Scott [23]. Since the study by Wilson, Scott has revised his earlier estimates and extended them to 1968-69 [24]. On the basis of these revised data from Scott, the estimates for land and improvements are reconsidered.

Gutman [16] in Australia and Tostlebe [26] in the U.S.A. refer to the distinction made between capital items that are gifts of nature, such as land, and capital items which are the result of economic decisions. It may be argued that land itself is fixed in supply and is therefore a constant input into any productive process so need not be included in estimates of the capital stock. Both Gutman and Tostlebe argue against this partly on the grounds that although land may be fixed in amount, its usefulness may be varied by effecting improvements to it. So long as improvements are adequately measured, this argument does not appear convincing. However, the amount of land used may vary. In Australia the area of land in all rural activities has varied significantly over the fifty years under consideration (see Appendix 5E), and represents a major argument for including land, as distinct from improvements, in farm capital. This contrasts with Young [28] for example, who excluded land in his study on the grounds that the additional land brought into production had zero or near zero unimproved value. While it is true that most of the land added to rural production in the past 50 years has been in S.A., W.A., N.T. and Qld., and is perhaps more marginal than had earlier additions made in N.S.W. or Vic., this assumption is questionable. In recent years, new technologies, such as identifying trace element deficiencies, has meant that previously unproductive (and zero value) land is now quite productive. Thus, in this study, land is included as part of capital, but in Chapter 10 an estimate of technological change is made without land included as part of capital.

5.2 Land Valuation Data

The use of land valuation data to measure land input is an attempt to account for differences in the quantity of land used by the rural sector. To assess the quality of these data, some appreciation of land valuation procedures is required. The starting point is the general procedure of valuing farming properties on the basis of recent sales of similar properties in the area. This itself is not entirely satisfactory because only a small proportion of the total number of properties are sold in any year. Estimating the value of all properties will mean assessing the worth of all properties that are not sold on the basis of those that are sold. Because of the heterogeneous nature of farms this will involve a degree of subjective evaluation on the part of valuers who could differ significantly in their assessment. These problems are exacerbated in periods of rapidly changing market prices as in booms and recessions such as the late 1960's slump in wool prices. In the recession case, increased uncertainty about the future discourages potential property buyers, while the "locking-in" of potential sellers because of high debt levels or optimistic expectations about farm product prices and property prices leads to a substantial reduction in the number of properties offered for sale [22]. Thus the market price for properties is not clearly defined, and the valuation task is more difficult. In boom conditions, however, these difficulties are reduced as a larger volume of sales makes valuation easier. Even so, many sales still have special characteristics that make them unsuitable for use as evidence of normal market prices [20], and market prices themselves may be changing rapidly.

A further complication arises through the lags in the land market response to changes in the economic situation in which farmers operate. This lag is likely to be longer when prices are moving down than when they are moving upwards. The reduced number of sales in downturns, means that less information on the state of the market is available to both potential buyers and sellers so the establishment of a market price is a longer process. A further lag occurs as valuers assess new situations and adjust their valuation guidelines to that new situation. This is reinforced by possible court challenges to valuation assessments so that valuers are hesitant to change their guidelines until a new trend is well established. For these two reasons valuations may lag two or three years or more, behind the changes in the economic conditions facing farmers.

The value of a property derives from the Ricardian concept of rent. Using the restatement of Clark [12, p.2], this may be defined generally as "the amount by which proceeds actually received exceed the minimum amount which would have been necessary to evoke the supply of the factors of production required". Clark proceeds to specify the minimum amount to keep land in production in the long-run as the "provision for maintenance, depreciation and interest on buildings and other fixed improvements". Any excess over and above these requirements is an economic rent and when capitalised provides the basis for land having value. Land itself (unimproved land) has no cost of production, so value does not derive from this source (but note the effects on land value of public capital infrastructure as discussed below).

The market price of the property based on capitalised rent will be influenced by a number of factors. Major factors influencing this price will be the market for agricultural products and the quality of the property, both the land itself and the improvements on it. But many other factors will also influence the price. First, there are discounts for risk where the degree of risk differs widely throughout Australia while the discount for a given risk would differ between farmers. Second, locational factors influence price through its influence on marketing costs between the farm gate and the consumer, retailer, wholesaler, or processor[1]. These costs will differ between farms and necessitate the use of farm gate prices in assessing farm returns. Further, farms in close proximity to urban areas will tend to be priced according to non-rural uses if non-rural use provides higher net returns. Third, administrative actions such as zoning regulations, tax concessions, land taxes, land tenure conditions, availability of credit, guaranteed product prices and subsidies for

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1 This embodies the concepts developed by Von Thunen and discussed in Clark [12, Ch.2].

example, will all affect land prices in some way [16, 23]. Fourth, land prices will also include any psychic satisfaction associated with farming. Finally, land as an asset for wealth holding, apart from productive use, may be important as an inflationary hedge, or a source of taxfree capital gains, which can influence the market price. The impact of these other factors on market prices will not be constant over time[1], and so valuations based on market prices for land, will also be influenced by these factors. In a productivity sense, where output is measured as the production of agricultural outputs only (thereby excluding other utility-giving benefits that accrue to farmers), valuations which reflect all aspects of the benefits of farming will tend to overstate the land input. But the sources of these errors are difficult if not impossible to identify so that no attempt is made in this study[2].

One of the important factors influencing the price of land and so land valuation is productivity. Yet the measurement and analysis of inputs and outputs as in this study, is aimed at assessing productivity. By measuring land input via valuation data, which to some extent reflects productivity, and then using that measured land input to help explain productivity levels involves a significant element of circular reasoning which is unacceptable. However, despite this deficiency, an attempt was made to use valuation data for two reasons. First, the link between productivity, as measured by capitalising the residual return to land, and actual land prices, is evident but not strong. This is detailed in Appendix 5A. Second, land valuation data is a neat and simple way of obtaining an estimate of the contribution to rural production of such factors as public capital infrastructure.

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1 Appendix 5A develops some evidence for Australia to clearly demonstrate this point and briefly refers to some evidence from the U.K, compiled by Clark [12].

2 The method developed in Section 5.3.3 generally overcomes this problem.

Land valuation data in Australia forms the basis for local government rating (taxes) and consists of one or other or both of the values of land and improvements combined (improved value) and the value of the land without any improvements (unimproved value). A definition of unimproved land was alluded to earlier, but there are many problems in obtaining a consistent time series of valuation data. These include inconsistency of definition between States, incomplete coverage of land in use, while only Tasmania has a complete improved and unimproved value series. Scott [23] has reviewed these difficulties and used various methods to derive a set of land values, both improved and unimproved, from 1930-31 to 1940-41 and 1945-46 to 1964-65. These series have subsequently been extended and revised to cover the period 1930-31 to 1968-69 [24].

In this study, the values have been extended back to 1920-21 using data compiled by Gutman [16]. Gutman used similar data sources to Scott, but adopted different procedures to fill gaps in the series which resulted in a set of values lower than the latest estimates of Scott. But Gutman's series extends only until 1947-48 for unimproved value, and 1945-46 for improved value. Thus, Scott's data is used for 1930-31 to 1968-69 without adjustment[1], and for 1920-21 to 1929-30 Gutman's series is used, adjusted upwards by a factor based on the relationship between the two series over the 1930-31 to 1945-46 period when both series are available. This factor is the mean ratio of the two series as there is no discernible trend in the ratio. Thus, for improved value, Gutman's series is raised by a factor of 1.325 while Gutman's unimproved value series is raised by 1.301. This procedure could introduce a discontinuity between 1929-30 and 1930-31 but this will not be large. These series are included in Appendix 5B. It

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1 Scott's estimates do not include 1969-70 valuation estimates but do include an estimate of the land area. An interpolated estimate for 1969-70 was obtained by using the land area, and the increase in land prices as indicated for N.S.W. by Macphillamy [22].

remains to subtract unimproved land value from improved land value to obtain a series for the value of on-farm improvements to land in current price terms. To obtain estimates of the quantity of these capital inputs it is necessary to deflate for price changes to obtain values in constant prices. It is these price change adjustments that are most difficult and to which attention is focussed.

5.3 Constant Price Estimates of the Value of Unimproved Land

The derivation of constant price estimates for unimproved land from current values requires an index of land prices. Macphillamy's study [20] highlighted some of the difficulties in constructing such an index but did compile an index based on the analysis of land sales data from the early 1940's on. Subsequently [21, 22], the index has been updated and two other indices compiled, one based on Reserve Bank Valuation Standards and the other on Valuer-General Unimproved Values. In seeking an index to deflate Valuer-General unimproved land values, an index based on this same data is obviously most suitable. The Reserve Bank data suffers from infrequent revision of the standards while sales data includes improvements as well. In fact, all three series move together fairly consistently, with some noticeable lags in the valuation based series particularly in the late 1940's and early 1950's. Although the index based on unimproved values has been updated less frequently than each year, this index has been used in a first attempt to obtain a constant price series.

Three major difficulties surround the use of Macphillamy's valuation based index. The first is that it relates only to N.S.W. so the use of this index for Australia as a whole will give inaccurate results to the extent that the distribution of land types will be other than that implied in the index. Second, the index is built up from information for selected shires which are included in the index with equal weights. This is unlikely to provide a weighting accurate in terms of various land types within N.S.W. Finally, the index exists only from 1939-40 to the present, leaving the problem of finding a suitable alternative for the period 1920-21 to 1938-39.

A number of possibilities were tried for the 1920-21 to 1938-39 period. These included a consumer price index, an agricultural product price index, the index of the cost of improvements used in Section 5.4 below and an index of local government rate income. In each case, the index was spliced onto the Macphillamy index to provide a complete index for the 1920-21 to 1969-70 period.

In applying these indices, a complication arises due to the interval between revaluations. This interval has been as long as six years in N.S.W., and Scott's series has made no allowance for this aspect. If the interval were six years and one sixth of the properties were revalued each year, then the value shown for unimproved land in period t would consist of values assessed over the past six years and would correspond to land prices over that same six year period. It is therefore consistent to deflate the unimproved value for period t by a lagged moving average land price index corresponding to the revaluation lag. The revaluation lag has been up to six years but averages about four years. But adding the lags (discussed earlier) in valuers responding to those changed prices, a six year lagged moving average price index could still be appropriate, and was used initially. Subsequently a three year lag and no lag were also used, but all gave unsatisfactory results.

The unimproved land series was deflated using the range of indices discussed above. A selection of results are included in Appendix 5C but in general they are unsatisfactory. Some problems arise in the post-1940 period, particularly during the period of rapidly rising prices of the late 1940's and early 1950's. The lag of valuations behind the rise in the price of land may have been greater than six years in this period. Thus, the index has increased too rapidly so that the constant price value of unimproved land shows a decline from the early 1940's until the mid 1950's. Over this period, all price series move rapidly upwards so that all of the price deflators that were considered gave the unsatisfactory result of a rapid fall in the constant price value of unimproved land. At other times in the post-war period, the results seem satisfactory.

The main source of dissatisfaction with this deflated series in the pre-1940 period is the level relative to the level of the 1950's and 1960's. Throughout most of the 1920's and 1930's, the level substantially exceeds that of almost all the post-war period in spite of the acreage of land in use being substantially larger from 1950 on than at any other time up to 1940. Thus, the main problem is the level of the deflated series pre-war relative to the post-war level.

A further unsatisfactory feature of the series relates to the 1930's, and the indicated decline in unimproved values. Collins indicated that the Federal Land Tax Department conceded reductions in values of 25 to 35 per cent over the 1928-29 to 1932-33 period[1]. The undeflated valuation data indicates only a 12.2 per cent fall in unimproved value over this period. Thus, the undeflated series does not reflect the real decline in the profitability of farming. However, with very few normal unforced sales of land taking place, it is difficult to assess the market price and so value of land.

This problem is not unexpected and derives largely from the use of surrogate price indices for a land price index. The main problem in using the surrogates is that the relationship between the surrogate price and land prices is not constant. In Appendix 5A evidence was presented to indicate that this occurred during the late 1920's and early 1930's. Thus, a simple price index is not likely to yield a satisfactory deflated series unless it is adjusted to take into account the effect of changing amenity and expectation factors on land prices. These problems are also quite evident in Wilson's study [27], but he accepted the price deflated series without substantial evaluation of these problems.

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1 Mr. H.G. Collins, former Chief Valuer of the Commonwealth Bank, commenting on an earlier draft of the paper on which this chapter is based.

5.3.1 A Digression on the Land Market

Valuation difficulties increase in times of agricultural depression, largely due to a reduced number of land transactions. The evidence of Macphillamy [22] clearly indicates that in N.S.W. the number of properties offered for auction fell sharply in 1961 and more recently in 1968 and 1970-71[1]. Furthermore, the proportion of these properties that were sold fell from a level about 45-50 per cent to around 30 per cent. Healy's [17] assessment of land sales in Western Australia shows a similar sharp fall in the number of properties changing hands in the years 1969-70 to 1971-72.

A brief examination of these facts in the light of market theory is warranted. A general downturn in the rural sector would be expected to influence both supply of properties to the market and demand for properties. Potential purchasers of land will be discouraged by factors such as the lower returns, dampened expectations, and higher potential investment returns elsewhere in the economy, hence demand for properties decreases. Existing farmers would be induced to leave for reasons such as higher returns from alternative employment and low incomes so the supply of properties to the market increases. This situation is shown in Figure 5.1 where D_1 and S_1 refer to an initial situation and D_2 and S_2 show the situation in depressed conditions. As indicated the price of land falls substantially from P_1 to P_2 to eventually equate the expected rate of return to farm capital with the "normal" rate of return for investments of similar risk. The number of properties sold is undetermined but depends on the relative size of the shifts in supply and demand, and the elasticities of the curves. However, the number of properties sold may be relatively stable.

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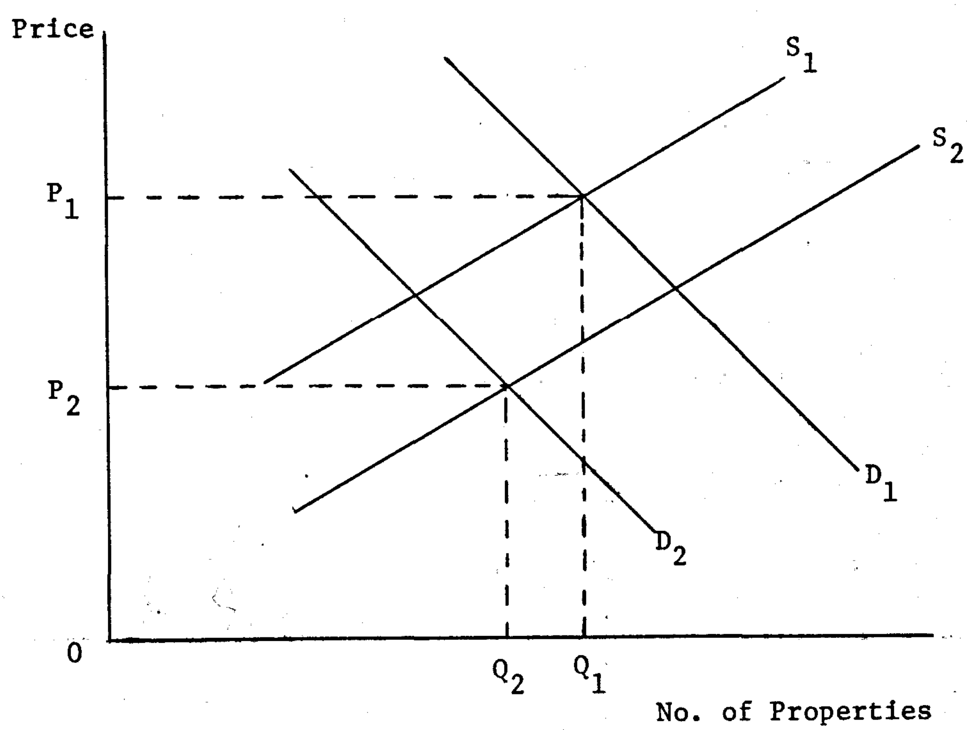
1 While auction sales may not be completely representative of all sales, it is likely that they indicate market trends fairly adequately. Private sales need to be handled carefully because of sales of a special nature such as sales within the family.

FIGURE 5.1

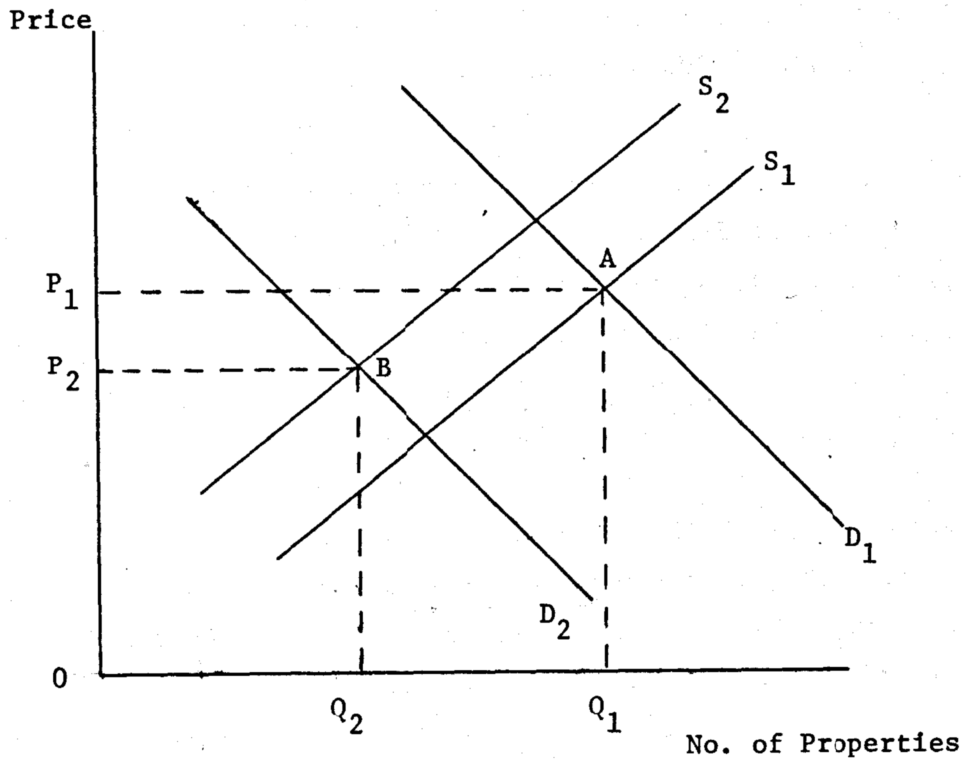
Market for Properties - Expected Situation



But the situation indicated in Figure 5.1 does not appear to fit the facts of a sharp reduction in the number of properties offered for sale, a reduction in the number sold, yet a relatively small decline in market price. A possible explanation may lie in the reduced number of properties offered for sale i.e. perhaps a shift in supply opposite to that of Figure 5.1 (referred to as the "shift" hypothesis), as shown in Figure 5.2. The points A and B correspond to the observed behaviour of only a relatively small price decline yet a substantial decrease in the number of transactions.

FIGURE 5.2

Market for Properties - "Shift" Hypothesis



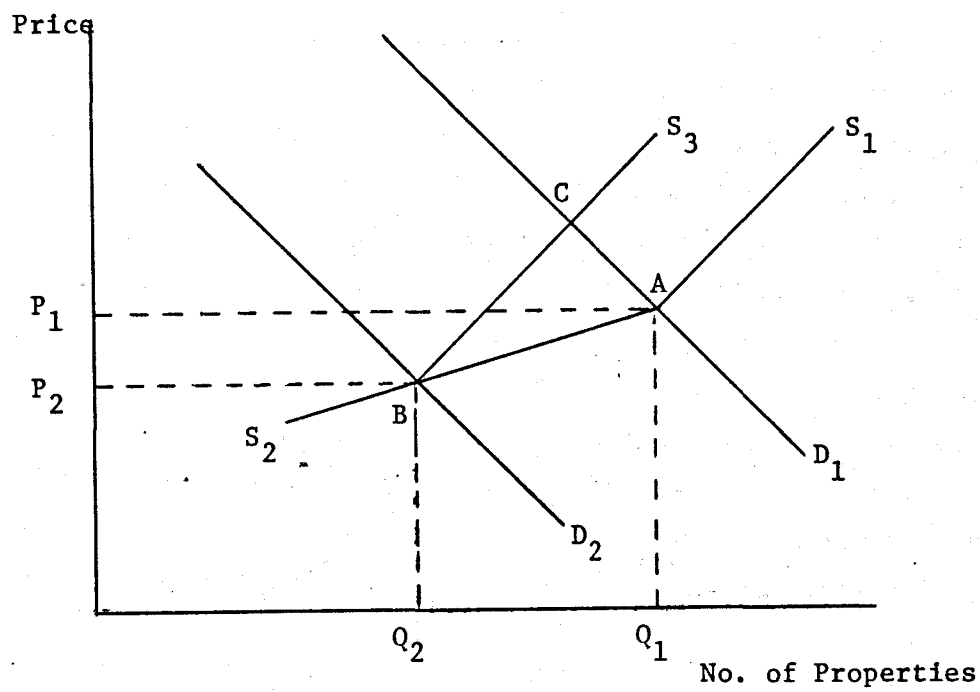
Is such a perverse supply shift justifiable? During major recessions which affect both the rural and non-rural sectors, it is possible to suggest factors inducing potential sellers from selling. First, the realisable value of the property fails to cover debts; second, unemployment levels make it difficult to obtain alternative non-rural employment; third, expectations of the future of rural industry tend to be optimistic (i.e. it can't get worse!); and finally, asset fixity factors particularly as they relate to farm owners and farm assets [18, 19], all tend to keep resources in agriculture and reduce the number of property sales. But this carries the implication that many property owners will now be induced to sell only at even higher prices, which would be difficult to justify. Furthermore, the outcome of a relatively larger proportional reduction in the number of properties sold than the reduction in price, can be attained without shifting the supply curve providing the supply curve is highly price elastic. For these reasons the shift hypothesis indicating substantial shifts of the supply curve appears unacceptable. The idea of a significant shift in demand is retained.

The hypothesis of the existence of a supply curve of high and relatively constant elasticity throughout, will also run counter to observed market behaviour. In more buoyant rural conditions, both the number of properties sold and the price tend to rise rapidly, implying a somewhat less elastic supply curve. In essence, this leads to the hypothesis of a "kinked" supply curve as shown in Figure 5.3. In this model, S_1 and S_3 reflect the lower elasticity corresponding to periods of increasing demand and rising prices, while S_2 reflects the converse. These circumstances lead to a ratchet pattern of price rises through time. Points A and B indicate the observed behaviour of market price and number of properties sold in a period of recession, with a subsequent recovery of prices to point C in more favourable periods.

An empirical test of these hypothesised supply and demand changes would be difficult. Apart from data problems, there would be substantial identification difficulties associated with an econometric analysis of supply and demand of properties. However, the kinked supply hypothesis would appear to be close to reflecting what the scarce data such as that of Macphillamy [22] suggests. If this is the case then the main result is that the factors relating the land price to the economic parameters such as agricultural input and output prices, change through time and particularly in relation to the agricultural business cycle. Conversely the influence of amenity and expectation factors also varies (see Appendix 5A). Thus in the absence of a suitable index of land prices, the compilation of a suitable index using some other price series as a proxy, will be difficult. Rather than embark on the determination of a complicated deflator index, an alternative method of assessing the input of land is considered.

FIGURE 5.3

Market for Properties - "Kinked Supply" Hypothesis



5.3.2 <u>An Alternative Unimproved Land Measure</u>

An alternative measure of land input is the area of land in use. The area could be valued over the whole period at base period prices so that the constant price capital value of land would change in response to the amount of land in use. The main deficiency of this method is that a hectare of prime tablelands grazing land is worth much more than a hectare of back-of-Bourke pastoral land. The use of a constant value figure will be accurate so long as changes in the amount of land comprise the same mix of land types as the total land used in Australia. While this may be unlikely, the errors introduced will probably be much smaller than if changing land area in use were ignored by excluding land as a factor of production.

A further substantial objection to using land area alone is the effect of public investment on farm returns. Public investment in roads, railways, telecommunications and irrigation for example, all increase in some way, the productivity of land. Irrigation benefits are obvious while transport and communication developments facilitate the marketing of outputs and the purchase of inputs. The improvement in education facilities, extension of television transmission, etc., will also have an impact on the psychic satisfactions of people living in rural areas. All of these public investments are important and substantial and in general are not included in the value of improvements[1]. Therefore, changes in the value of unimproved land should arise from changes in land area, in public infrastructure, or market prospects for agricultural production. The use of unimproved land values was intended to be a relatively straightforward way of accounting for all these factors simultaneously. However, the use of unimproved values proved unsatisfactory for the reasons discussed in Section 5.3.1 and Appendix 5A.

An alternative procedure outlined below, attempts to assess separately the land input due to land area, and that due to investment in infrastructure which benefits agriculture. Gutman [16] used this method for public investment in irrigation and water conservation but ignored other public investment and land itself. Irrigation investments

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[1] To some extent these off-farm investments will have an impact on the value of improvements. For example, where public investment results in higher market returns for output, and that some output is attributable to on-farm improvements, then some benefits would be capitalised to improvements. However most benefits from social infrastructure would be reflected in the value of unimproved land.

can justifiably be added to agricultural capital but some irrigation schemes have a multi-purpose function (e.g. the Snowy Scheme). The main difficulty is to determine the proportion of the investment in these projects that should be attributed to agriculture.

Land area is accounted for by applying a constant per acre value to the land area data compiled by Scott [24][1]. There is no information for any year on the proportion of the unimproved land value that can be attributed to land and that due to public investments. Thus, an arbitrary proportion of 20 per cent due to public investment was assumed. Using Scott's estimates of the unimproved value of rural land in 1949-50, the base year, this gave land a value of $924 m. or $0.85 per acre, and $231 m. or $0.21 per acre due to public investment. In all years, land was valued at a constant $0.85 per acre. The public capital component is adjusted using an index of public capital in rural areas. The compilation of this index is described in Appendix 5D, and the index of rural public capital is shown in column (6) of Table 5D.1.

This index with 1949-50 = 1.00 is used to deflate the public investment component of unimproved land which was assumed to be $231 m. in 1949-50 (see above). The land area and public investment components, and total land input (the sum of the two components) are included in Appendix 5E and shown diagrammatically in Figure 5.4.

5.3.3 Discussion of the Unimproved Land Estimates

Despite the heroic nature of these estimates they explicitly take account of two basic components of the capital value of land used for primary production, namely the area of land used, and the benefits to agriculture of public investment in providing general social infrastructure and facilities. Both components indicate trends which can be reconciled with circumstances operating in the economy. But there could be some dangers in attributing too much significance to minor irregularities in the series, particularly the land area component.

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1 Prior to 1938-39, estimates of the area of rural land were derived from Scott's estimate of total (including urban) land.

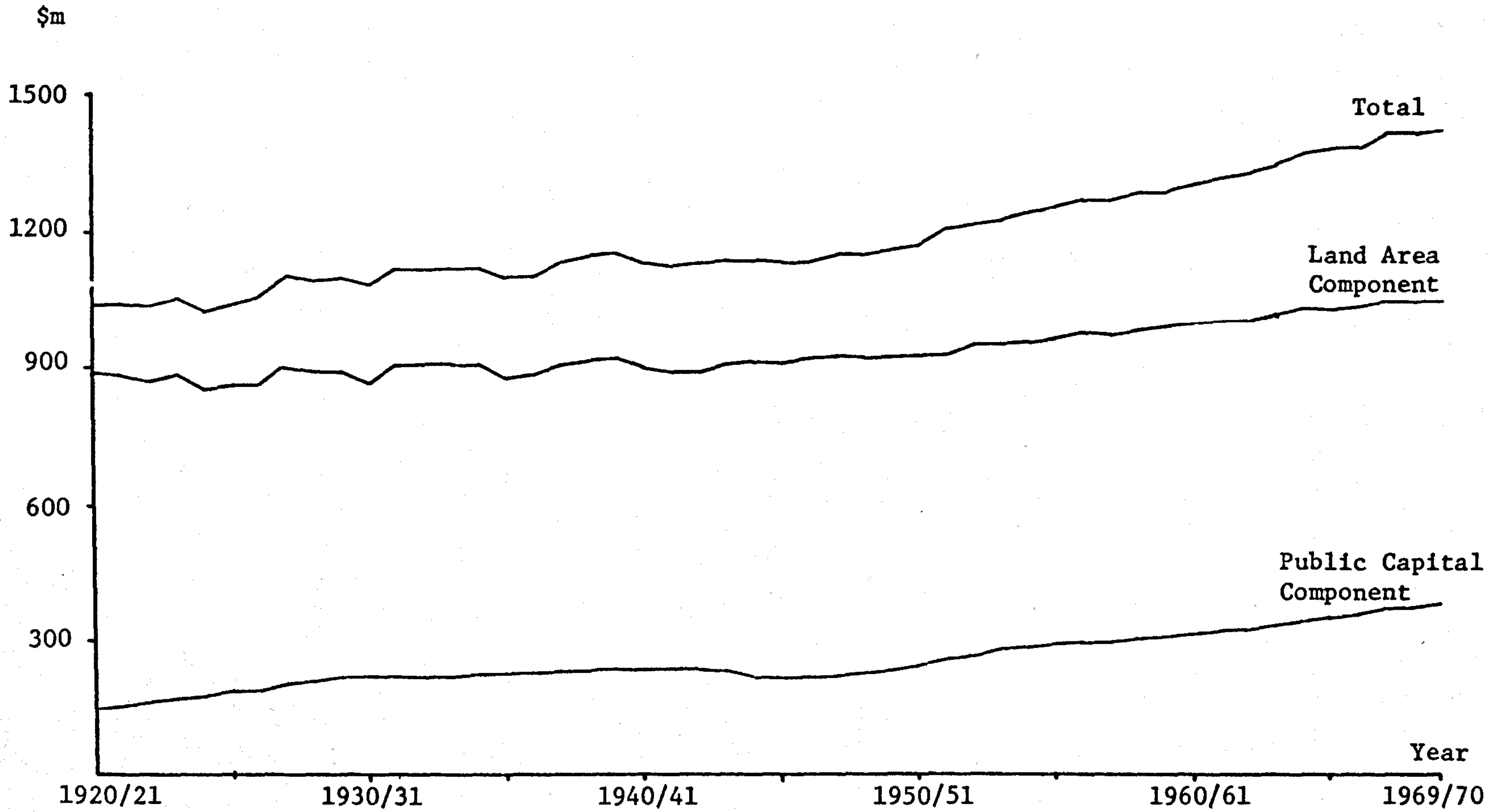

FIGURE 5.4

Unimproved Land Input in Australian Agriculture, 1920-21 to 1969-70: $m, 1949-50 prices.

The land area component declines slightly in the first half of the 1920's as the boom conditions prevailing at the beginning of the decade abated. The return of buoyant conditions in the second half of the 1920's resulted in an increase in land used despite unfavourable seasons, which was maintained during the depression of the 1930's when there was a tendency for the population to drift back to rural areas. Further expansion began in the late 1930's to be forestalled by the Second World War which drained labour from rural areas and diverted supplies of materials from rural uses to the war effort. Since the war, a fairly steady expansion of the land area has occurred.

The public capital component shows a similar trend to that of the land area. There is a high level of investment in the 1920's followed by very little investment during the 1930's and the first half of the 1940's. Since then, investment has been sufficient to provide a steady increase in the public capital stock. These trends correlate well with a recent commentary by Sinclair [25] on capital formation in Australia in this century. Sinclair elaborated a view that public capital formation, railways, roads and irrigation in particular, was accorded high priority in the 1920's. This was a keystone of policies to diversify the rural sector and intensify settlement. From the 1930's on, increased manufacturing and urbanisation forced a greater amount of public capital to be directed towards urban development. This trend occurred in addition to the slowdown created by the depression and World War II. The post-war period saw a strengthening of the trend towards more urban public capital investment while rural investments were concentrated on intensifying production in areas already well settled. In this regard irrigation works were accorded a high priority.

This encapsulated statement of the main themes of Sinclair's argument confirms the trends illustrated in Figure 5.4 and detailed in Appendix 5E, but does not confirm the values in a quantitative way. In this context, two aspects are significant. First, the swing in the emphasis of public capital investment referred to by Sinclair may be greater than[1] that reflected via the allocation based on the share of rural G.N.P. to total G.N.P. If this were so, it would further accentuate the rise in the public capital component in the 1920's which is already the decade of most rapid growth. Following this point through would lead to an even worse rural growth record in the 1920's than is portrayed in later estimates. Sinclair [25] also argued that much of the public investment in the 1920's was poorly planned and evaluated and so did not contribute to increased rural output as effectively as it may have. This aspect of the performance of the rural sector in the 1920's is considered later in the context of the analysis of technological change.

The second factor is the division of the 1949-50 value of unimproved land into the two components in the proportion 80 per cent land area and 20 per cent public capital. This division will not lead to any errors in the estimate for 1949-50, but it will for other years because land area and public capital have increased at different rates. Over the fifty year period land area has increased by 17 per cent while the public capital stock has increased by 153 per cent. Using the 80:20 ratio, the increase in total land input is 36 per cent. If more than 20 per cent of the 1949-50 value is due to public capital infrastructure, then the levels of total land input indicated in Figure 5.4 would be overstated prior to 1949-50 and understated for years following 1949-50. For each one point error in the 80:20 ratio, the rate of increase in total land input as shown will be in error by approximately one per cent. As an example, changing the ratio by 30 points to 50:50 results in the percentage rate of growth of total land input rising from 36 per cent to 71 per cent for the fifty years. While this level of sensitivity to a vital assumption is discomforting, the likely margin of error in the 80:20 ratio in 1949-50 could hardly be more than 10 points. This

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1 It could also be less but this would be unlikely.

magnitude of error is tolerable given the desire to include unimproved land in the capital stock. Certainly, inclusion of unimproved land on this basis is preferable to the price index deflated basis discussed in Section 5.3.

A similar conclusion relates to the assumed 3 per cent depreciation rate for public capital. While the whole concept and role of depreciation in productivity analysis is not clear, depreciation is still relevant in the context of assessing the productive stock of capital. This may be primarily as a measure of technical obsolescence, or a measure of mislocation of fixed public capital as a result of economic development. For example, subsequent development may change production patterns in such a way that certain railway lines are no longer most suitably located. The 3 per cent rate has been used knowing it to be an approximation, and that a higher rate will have dampened the growth in the index derived in Appendix 5D which is used to estimate the public capital component. This would have the effect of slowing the growth in total land indicated in Figure 5.4.

5.4 Constant Price Improvements to Land

In Section 5.2, a current price series for the stock of improvements was compiled from Scott's data. This stock was determined as the difference between the value of improved land and unimproved land. Given the discussion in Section 5.3 on the inadequacies of the price deflated unimproved land series, it is pertinent to reassess the validity of using this method of estimating improvements.

Two main reasons can be advanced to support the method. First, most of the problems of the unimproved land series discussed in Section 5.3 are problems of finding a suitable price index to deflate the current price series to a constant price series. This arose because the value of unimproved land had not kept in some constant relationship to the net return accruing to land. But this is unlikely to be a serious problem in the case of improvements because both the improved value and the unimproved values tend to move in unison in response to all factors influencing the land market. If this is the case, then the relationship between improved and unimproved value would have been relatively constant, and reflect the value of improvements.

Second, improved values are likely to be more reliable than unimproved values, at least in recent years, because it is generally easier to obtain comparable land sales data for improved values than for unimproved values. Further, any tendency for valuers to assess unimproved values as improved value less the depreciated replacement cost of improvements[1] would help to establish the difference between the two values as a reasonable estimate of the replacement value of improvements to land[2]. Thus, for these two reasons, improvements as estimated in Section 5.2 are used in this paper. This procedure was also used by Gutman [16] and Wilson [27]. Gutman [16, p.272] made similar points to those discussed above stressing that the valuation procedures were applied relatively uniformly across States, and that these valuations were largely independent of the problems of valuation of unimproved land.

The improvements to land considered here relate to those existing on the farm. The on-farm improvements can be clearly identified as such things as clearing, pasture development, fencing, water supply, buildings and so on. It should be noted that improvements will include the value of the farm-house which is being included in the value

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1 This practice would probably be of increasing importance throughout the period under consideration because of the increasing difficulty of obtaining reliable sales data for unimproved land, given that there is very little, if any, virgin land remaining in some areas.

2 This procedure tends to leave unimproved land value as a "residual" component of price behind the more easily assessed improvements, and therefore includes all the miscellaneous factors discussed in Section 5.3 which make it difficult to "explain" unimproved land values.

of capital used on the farm, yet the value of the service it provides is not included in output of rural industry. This was discussed in Chapter 2, along with reasons why further consideration is not given to this aspect.

Under competitive conditions and in the long run, investment in improvements would be undertaken so long as such investments yield a positive net present value calculated at the market rate of interest. In this case the cost of the marginal investment in improvements would be equated with the market valuation which would reflect the net return due to that investment. These assumptions are unlikely to be fully met in the short run, but in the long run they provide a basis for assuming that market valuations approximate the depreciated replacement cost of those improvements. Further, any tendency for valuers to assess the unimproved value by deducting the depreciated replacement cost of improvements from the improved value, would make for a close link between the value of improvements and their replacement cost. Against this background, it is considered reasonable to deflate the current value of improvements by a price index of the cost of items used in effecting improvements to land. The compilation of this index is detailed in Appendix 5F.

To deflate the current price series, a six-year lagged moving average of the improvements index has been used. This is to allow for lags associated with infrequent revaluation of properties and other factors related to valuation methods discussed earlier. Both the current price and constant price series for improvements are included in Appendix 5G and the constant price series is shown in Figure 5.5.

5.4.1 Discussion of the Improvements Estimates

This series is significant in that it indicates the importance of improvements as a component of farm capital and correspondingly as an avenue of investment. But there are some problems with the series.

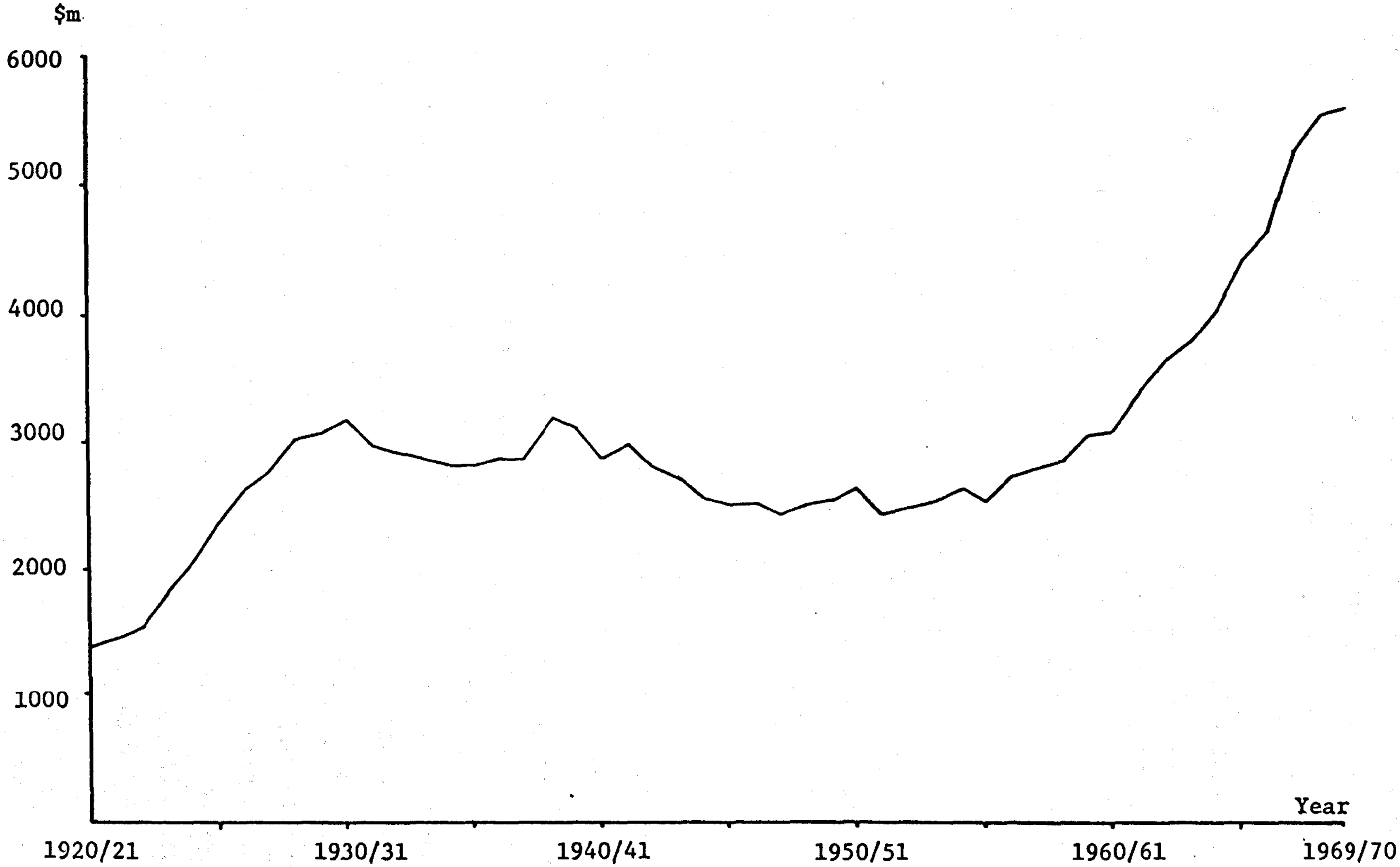

FIGURE 5.5

Improvements to Land in Australian Agriculture, 1920-21 to 1969-70: $m, 1949-50 prices.

First, there are some irregularities that may be artefacts rather than real fluctuations such as the sharp fall in the level between 1930-31 and 1931-32 which is due to the linking of Gutman's series to that of Scott (mentioned in Section 5.2).

Second, the series exhibits shades of the valuation-deflation problem discussed in relation to unimproved land. The level of the series in the late 1920's was not regained until the 1960's while the level increases very slowly during the first half of the 1950's. These aspects are likely to be related to the problems associated with the use of a cost based index of improvements when in fact improvements are being valued on the basis of the analysis of property sales. The relationship between market valuation and the cost of improvements is likely to be most tenuous in periods of rapid change and uncertainty. The depressed 1930's and the period of rapid inflation in the late 1940's and early 1950's are suspect on the basis of the adequacy of the index based on costs, and the attitudes of valuers in adjusting to the rapidly changed circumstances. These factors may be responsible for some over-estimation of the level of improvements in the 1930's and underestimation in the early 1950's. These and other issues relating to improvements will be considered again in Chapter 9.

Allowing for the above comments, the series appears satisfactory in relation to economic circumstances. There was a rapid increase in the 1920's, followed by a long stagnant period through the depression, the Second World War and the aftermath of the war when many important materials were still in short supply. Since the mid-1950's there has been a steady and rapid increase in the stock of improvements on farms.

There is a paucity of data suitable for comparison with this series. Perhaps the best comparison of the estimated value of improvements can be made with data from the A.S.I.S. [7, 8, 9]. However, there are some definitional problems that make the comparison difficult. The A.S.I.S. defines improvements as including buildings, fences and water facilities, thereby excluding land clearing and pasture development works as well as the farm homestead. All of these items are included in the estimates contained in this paper. The A.S.I.S. had sample properties independently valued in 1954, 1960 and 1967. The sample data, the number of farms from which the sample was drawn (about 90,000 farms) and the number of commercial farms in Australia (about 200,000 [2]) provided the basis of an estimate of the value of improvements on Australian farms. The results and a comparison with the estimates made in this study are shown in Table 5.1.

TABLE 5.1

Comparison with A.S.I.S. Estimates of Improvements
(current prices)

Year	A.S.I.S. $m	Present Study $m	A.S.I.S./Present Study %
1954-55	2,250	3,815	59
1960-61	2,954	5,172	57
1967-68	4,581	8,566	53

The low A.S.I.S. estimate relative to this study is expected because it excludes farm homesteads and all land clearing and pasture developments. Further, the increasing importance of land and pasture development during the 1950's and 1960's is reflected in the relatively lower A.S.I.S. estimates for 1960 and 1967. A general comparison can be made by assuming that each commercial farm (approximately 200,000 farms) includes a house for the owner-operator or manager valued conservatively in 1967-68 at $5,000. By taking the estimate of improvements made in this study, $8,566m and deducting the A.S.I.S. estimate of improvements $4,581m and the estimated value of housing $1,000m, this leaves $2,985m for land clearing and pasture development. Using Scott's estimated area of 1,228m acres this is $2.43 per acre. Even allowing for the vast areas of land which have not been cleared or do not carry improved pastures, this level would not seem to be excessive. A more precise comparison is not possible, but the level and trend of the value of improvements estimated in this study is supported by the A.S.I.S. data.

Further evaluation of the improvements series can be made by comparing the series with other data relating to the physical level of some components included in improvements. These include the area of land irrigated, the area of sown pastures, the amount of land fertilized and fertilizer used, and total crop area[1]. For the purpose of this study, three of these have been included; irrigated area as an indicator of the importance of irrigation, the area of sown pastures as an indicator of pasture improvement developments and associated fences and water supply facilities and crop area as an indicator of the development of land to an arable level (clearing of rocks and trees in particular). These series, so far as data are available [4], are shown in Figure 5.6 along with the constant price improvements series. The series are expressed as indices with 1949-50 = 100 to enable an easy comparison of the trends.

Figure 5.6 indicates that the rapid increase in improvements during the 1920's coincided with an expansion of both crop and irrigated area. Pasture development was not so important. The 1930's and early 1940's saw few developments with crop area declining, and small increases in sown pastures and irrigated area. Over this period, the constant price level of improvements tended to decline. This decline may be

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1 It would be desirable to include details on land clearing but little data is available on this aspect apart from some estimates for the years 1929-30 to 1941-42, [4, 1939-40 to 1941-42 issues]. In 1929-30, new land cleared in Australia excluding Victoria totalled 1.5m ac. This fell sharply in subsequent years to less than 0.5m ac. in 1934-35, and then began to climb for the remainder of the 1930's. The most substantial reduction in land clearing in the 1930's occurred in W.A. which fell from almost 0.8m ac. in 1929-30, to only a little more than 0.1m ac. in 1934-35.

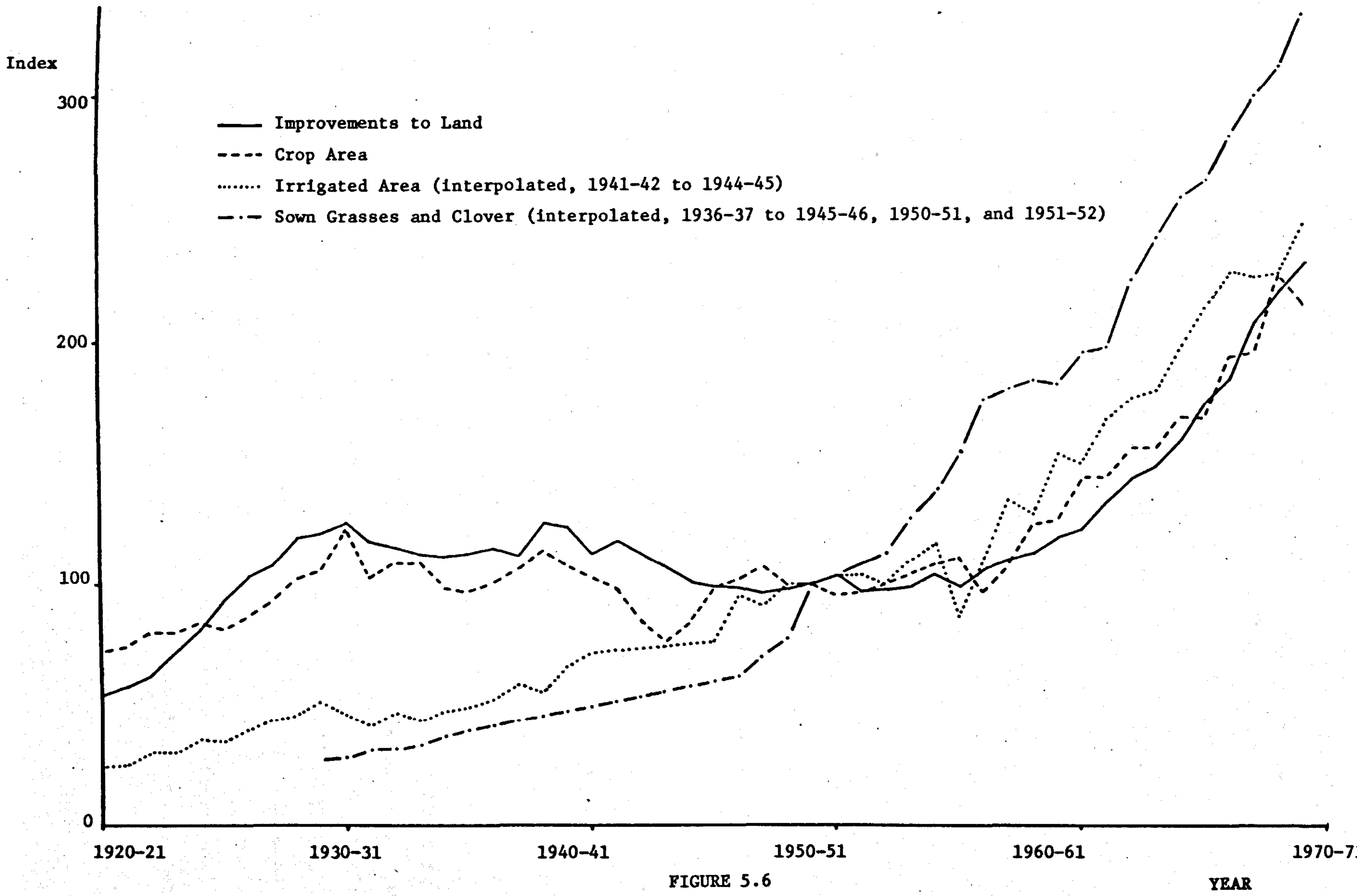

FIGURE 5.6

Indices of Improvements to Land and Selected Components, 1920-21 to 1969-70: 1949-50 = 100.

concentrated in the structural type of improvements which generally involve purchase of materials, rather than land clearing, pasture and irrigation developments which can be carried out with the use of on-farm labour and machinery. The depressed conditions of the 1930's would have provided little cash for purchase of materials while the 1940's were characterised by shortages of many materials.

In the post-war period, the area of sown pastures expanded rapidly from the end of the war whereas the rapid expansion of crop and irrigated area did not begin until the mid-1950's. No doubt the wool boom of 1950-51 and the reappraisal of agricultural policy in 1952 were factors influencing this sequence of events. From the mid-1950's to 1969-70, all three series show a rapid increase corresponding to the rapid increase in improvements. It is notable however, that the rapid expansion in irrigation and crop area began at least 5-6 years after the expansion of sown pastures.

The above comparison lends support to the general trends indicated by the constant price level of improvements. More detailed analysis of other components included in improvements, such as buildings, fencing and water supply facilities would complete this assessment. Data limitations are likely to preclude such analysis, so that the comparisons made above will have to suffice at this stage.

5.4.2 A Note on Depreciation of Improvements

In compiling the estimates of the stock of improvements it was not necessary to estimate depreciation on improvements because current price stock estimates (valuation data) were available for the entire period. However estimates are required for two purposes. First, in calculating factor output in Chapter 8 an amount of output is allocated to maintaining the capital stock intact. This applies to the replacement of the stock as distinct from normal repairs and maintenance. Second, in estimating gross investment in improvements, replacement expenditure is required in addition to the net investment component. An estimate of depreciation will fill this requirement.

Gruen, Campbell and Crawford [15] commented on the inadequacy of information on real capital consumption in the rural sector. The official estimate contained in the A.N.A. [1] is based on taxation data and includes the biases arising from government policies which frequently include accelerated rates of depreciation[1]. Both Gruen [14] and Glau [13] have since calculated alternative estimates of depreciation but they both analyse capital stock data which largely excludes capital produced by the use of on-farm capital and labour resources. Further, their estimates do not separate total depreciation according to capital components. Thus, this study calculates an estimate of depreciation of improvements, and in Chapter 7, plant and machinery. The other components of capital are assumed to be non-depreciating.

The estimation of depreciation on improvements is a hazardous and arbitrary process because of the diverse components that make up improvements. These range from fences and buildings which may depreciate at a 2 or 3 per cent rate, water supply facilities, 2 to 10 per cent, and irrigation facilities which may range from 0 to 10 per cent. The more difficult components however, are land clearing and pasture improvements. In most land clearing, there is no depreciation and even in cases where regrowth is a problem, this should be controlled by appropriate maintenance expenditure. Pastures however, are likely to deteriorate despite appropriate maintenance being carried out. This may be reflected in the need to resow non-persistent species, or to replace pastures lost in floods and droughts. In addition to these problems, there is a lack of information on the relative importance of the various components in total improvements and it is certain that the relative importance of some components has changed considerably over

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1 For a discussion of these aspects see Glau [13, Appendix A].

the 50 year period. In particular, pasture investments were more important in the 1950's and 1960's than in earlier years. Some guidance to the relative importance of the main components, fences, buildings and water supply, can be obtained from the A.S.I.S. but even within these groups there is a diversity of rates of depreciation.

In view of these difficulties, a simple but arbitrary estimate is made by assuming that collectively, improvements depreciate at a 3 per cent diminishing balance rate. To the extent that improved pastures may depreciate at a rate greater than 3 per cent, and that this component has grown rapidly during the 1950's and 1960's, this may underestimate depreciation in these decades. However, in the absence of better information no attempt has been made to allow for this and other similar factors. This estimate of depreciation in constant price terms is included in Appendix 5G. Further discussion of the depreciation estimates is included in Chapter 9.

5.5 Some Concluding Comments

This chapter is important for two reasons; it introduces a new approach to measuring the input of unimproved land, and provides estimates of the most important area of farm capital, that of improvements to land. This latter aspect is closely related to the problems of measuring investment carried out with the use of on-farm resources.

The measurement of unimproved land in constant prices was a major problem stemming from the difficulties of satisfactorily deflating valuation data and the wish to avoid circular reasoning in measuring land inputs. The method subsequently adopted separated out the spatial aspect of land, and the public capital infrastructure as basic components of unimproved land that contribute to rural production. This extended a procedure used by Gutman [16], which he applied only to the irrigation component of public capital infrastructure, to the whole of public capital infrastructure related to the rural sector. While the assumptions employed in this study can be considered heroic, the resultant estimates are considered superior to any estimate derived from procedures based on deflating valuation data by a suitable price index. However, there is considerable scope for refinement of the estimates used in this study, particularly the public capital infrastructure component. This can be based on detailed analysis of public capital expenditure, and the influence of this expenditure on rural production, productivity and so the value of land.

The assumptions behind the estimates of improvements to land are less heroic than in the case of unimproved land. The key element is that improvements can be measured accurately as the difference between improved value and unimproved value. Some reasons why this is likely to be so were advanced in this chapter, and deflation procedures evolved. The resultant estimates are comprehensive, embracing all forms of improvements to land from fixtures such as fences, buildings, and tanks to land clearing and pasture improvement. Further, there is no discrimination between investments which were purchased entirely and so recorded in capital expenditure, or were partly or wholly produced by the use of on-farm labour and capital, and so incompletely recorded in capital expenditure estimates such as those included in the A.N.A. [1]. Apart from Gutman [16] and Wilson [27] who estimated improvements on a similar basis to that used in this study, other estimates have been selective in terms of items included. For example, Butlin [10] excluded land clearing, pasture development, and the establishment of vineyards and orchards, the importance of which was pointed out by Boehm [5], while Young [28] restricted his estimate of investment to that recorded in the A.N.A. [1]. A quantitative comparison of the main alternate estimates of capital formation in the rural sector, both in total and in the major components, is deferred until Chapter 9.

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CHAPTER 6

CAPITAL: II - LIVESTOCK

6.1 Introduction

6.2 The Estimated Number of Livestock

6.3 The Estimated Value of Livestock

6.4 Discussion of the Estimates

6.5 References

CHAPTER 6

CAPITAL: II - LIVESTOCK

6.1 Introduction

Capital in the form of livestock is more readily estimated than other components of capital because of the relatively more abundant useable data available from the A & P census [2]. Some reservations apply to these estimates because they are based on farmer estimated stock numbers which are almost certainly not completely accurate. However, it is probably reasonable to assume that any bias arising from this source is relatively constant through time. A second problem is the varying census dates prior to 1943. These varied between States, and over time for particular States, but in general, were held between December 31st and June 30th[1]. Since 1943, all States have used the March 31st census date. As there is no data to provide a basis for adjusting the pre-1943 estimates to a common census date, there is no alternative but to use the published data as though a uniform census date had been applied. Finally, for this study, the capital estimate based on March data has been considered to be the capital input for that financial year, i.e. the capital input for 1920-21 is based on livestock capital assessed at March 1921. In assessing investment in livestock capital, the increase between March 1920 and March 1921 represents investment carried out in the year 1920-21 (July 1st 1920 to June 30th 1921).

Current price valuation of livestock is not a satisfactory starting point for estimating livestock capital. Livestock prices are a reflection of the value of livestock products on the market. Thus, using livestock prices to measure capital, which is then used as an input to explain the level of output, involves circular

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1 For details, see the explanatory notes in the Rural Industries Bulletin [2].

reasoning of a similar nature to the use of market valued land input to explain output. Thus, prices must be used carefully, primarily as a means of aggregating different types of livestock, but not for measuring changes in the amount of livestock capital. Changes in the amount of livestock capital are more accurately assessed from changes in the actual number of livestock and valued at a specified set of values for each class of livestock. In essence, this is the method used in this study.

The main deficiency in this method is that it ignores changing quality of livestock which would have been significant over this fifty year period. As a result, any growth in output contributed by improved livestock quality will be attributed to the technological change residual. This method can be defended on two grounds. First, these quality changes are a component of technological change as defined for this study (see Chapter 1). Identification of quality changes, and adding these to capital is not the task of this study, but would be necessary in a study along the lines of Jorgenson and Griliches [7] or Denison [4].

Second, the isolation of a quality change factor will be difficult because it will be closely related to a variety of other aspects of agricultural development. For example, higher calving and lambing percentages may be largely the result of better pastures and feeding management as well as the stock themselves being genetically superior. Similar considerations would be relevant for increases in wool cut per head and the growth rates of sheep and cattle. Thus the isolation of the quality change factor in livestock themselves in terms of some genetic characteristics would be difficult.

The alternative means of allowing for quality change via prices for livestock is equally difficult. Observed price changes will include the effects of quality change in addition to market forces. Even if adequate price data for livestock were available the task of "deflating" for changing market forces and leaving the underlying quality change would appear near impossible. Thus quality change in livestock has been ignored in this study so that technological change would tend to be overestimated as a result.

6.2 The Estimated Number of Livestock

The procedure used is to obtain an estimate of the number of livestock in the main livestock classes, and then to value the stock in each class at its respective estimated base period price. The values for each class are aggregated to provide the total livestock estimate. This procedure is similar to that used by Gutman [6], Wilson [8], and Young [9].

The classes of livestock used were beef cattle, dairy cattle, sheep, pigs, horses and poultry. For sheep, pigs and horses the A & P data has been used without any adjustment. These estimates relate to stock on farms as at March 31st each year, and are tabulated in Appendix 6A. Some adjustment and interpolation was required for the cattle and poultry components. These are now discussed briefly.

(i) Cattle numbers

Data on cattle numbers in total is available for the entire period, and form the basis of the cattle estimates. Limited data is available on dairy cattle and this is used as a basis for separating cattle into beef and dairy categories. Such a division is not easily made because of the tendency for dairy type cattle to be used for the production of beef such as vealers, while dairy herds produce cattle for slaughter in addition to milk production. Some changes in statistical collection procedures have been made and were aimed at clarifying the classification of cattle into beef and dairy cattle. Such a change was made for the A & P census, March 31st 1964[1]. Prior to

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[1] For details see the explanatory notes in the Rural Industries Bulletin [2].

this date, farmers classified herds as either beef cattle or dairy cattle, with resulting confusion as to whether the classification should be by breed or purpose. Since 1964, the classification has been specifically based on purpose, that is, milk production or meat production. This introduced a discontinuity into the dairy cattle series. There is no official published information on the effect of this change on dairy cattle numbers, but a comparison of the estimated dairy cattle numbers in 1963-64 with 1962-63 indicates a change of less than 5 per cent in dairy cattle numbers. This is a small effect so that no adjustment has been made for this factor.

Of more importance is the lack of any estimate of dairy cattle apart from dairy cows for the 1920-21 to 1941-42 period. To derive an estimate of dairy cattle for this period, the number of dairy cows has been inflated by the average ratio of dairy cattle to dairy cows for the 1942-43 to 1962-63 period. The ratio was calculated for each State for each year and as there was no significant trend in the ratio, the average value was used. The ratios used were, N.S.W. 1.414, Vic. 1.582, Qld.1.491, S.A. 1.594, W.A. 1.734, Tas. 1.705 and A.C.T. 1.532. Summing the estimated number of dairy cattle in each State resulted in the Australian total.

Beef cattle were derived as the residual after deducting dairy cattle from total cattle in Australia.

(ii) Poultry numbers

Data on poultry is the most inadequate of all livestock. Poultry numbers are more difficult to estimate because of the large number of birds kept in backyards either farm or non-farm. For this reason alone, it seems likely that the available estimates contain substantial inaccuracies and inconsistencies in collection procedures. However, wherever official statistics are available, they have been used, and the gaps filled by interpolation, either linear, or on the basis of movements in the estimates for other States where available.

In this way, a series for fowls, ducks, geese and turkeys for each State has been compiled[1]. These have all been added together as though they were homogeneous to obtain a total for poultry. While the data for poultry is quite suspect, and the aggregation crude, poultry is not a large proportion of total livestock capital (less than 2,5 per cent). Thus even substantial errors in the poultry data will not lead to major errors in total livestock capital.

The estimated number in each livestock class is tabulated in Appendix 6A.

6.3 The Estimated Value of Livestock

The value of livestock, valued at estimated 1949-50 prices is shown in Appendix 6B. The estimated 1949-50 prices were beef cattle $35.00, dairy cattle $45.00, sheep $5.00, poultry $1.00, pigs $10.00 and horses $40.00. These prices differ from those used by Gutman [6] and Young [9] as they used different base years. They also differ from those used by Wilson [8] for the same base year and this is due to the exercise of a certain amount of judgement in determining the set of prices. This set was arrived at after keeping two factors in mind. First, they should be reasonably representative of prices prevailing for those livestock classes during 1949-50. Second, they should maintain a reasonable relativity between the various livestock components, particularly between the main components sheep and cattle.

To achieve prices approximating the 1949-50 level the various State yearbooks and/or statistical registers were consulted. Only a limited amount of guidance can be obtained from this information because it applies to fat stock sold at the main metropolitan markets. Much of the stock held on farms would be classified as breeding or store stock, the prices of which will be closely related to fat stock

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1 These detailed series are not included in this study but are available in a separate unpublished paper [1].

prices, but are unlikely to be identical to fat stock prices. Furthermore, the range of the price quotations is considerable given the varied types and qualities that are marketed within each livestock category. Thus, the selected price reflects an amount of judgement exercised by the analyst.

Within the range of quoted prices, a level has been selected to maintain relativity between categories of livestock. As there is less disparity between types and classes of sheep than there is between types and classes of cattle, a price was established for sheep of $5.00 per head. The cattle prices were then established relative to sheep using the approximate sheep equivalents of cattle. For beef cattle, this is estimated at seven and for dairy cattle, nine. Thus, $35 and $45 respectively were chosen which fell well within the quoted price ranges for fat cattle. The sheep price however lay near the lower end of the range because by 1949-50, prices had already begun to move upwards at the beginning of the wool boom.

In terms of measuring changes in productive capacity of the livestock capital, it is more important to specify accurately the relativities between livestock than the absolute value. The relative price of sheep to cattle has varied from as low as 0.25 (4 sheep = 1 head of cattle) in the early 1950's to 0.05 or more (20 sheep or more = 1 head of cattle) in the late 1960's. But while this ratio may vary substantially, the productive capacity of that livestock remains relatively constant when output is measured in constant price terms. Ideally, the relativity between sheep and cattle should be assessed in terms of relative productive ability. This is to ensure that $x of livestock capital as either sheep or cattle has identical ability to produce output. While endless and inconclusive debate could take place on this aspect it seems reasonable to base the ratio of sheep to cattle on established conventions such as the relative feed demands of sheep and cattle. The ratios of 7:1 for sheep : beef cattle and 9:1 for sheep : dairy cattle, would seem to fulfil this requirement.

The above discussion has concentrated almost entirely on sheep and cattle. This is due to the overwhelming importance of these two components in total livestock, and the need to establish the relativity with reasonable accuracy because of the possibility of substantial substitution of one for the other over a large proportion of Australia. Furthermore, price information on livestock other than sheep and cattle, is more sketchy and virtually non-existent in the case of horses. Thus, the estimated prices for these components are much more subject to error. However, on the basis described above, these components collectively represent up to 11 per cent of total livestock in the 1920's, and as little as 5 per cent in the 1960's. Thus, any errors in the poultry, pig and horse estimates are likely to be quite small when viewed in the context of total livestock capital.

6.4 Discussion of the Estimates

The estimated values from Appendix 6B are shown in Figure 6.1. A number of aspects deserve comment.

(i) There is a significantly faster rate of growth in livestock capital post-World War II than pre-war. In the early years, this was largely a recovery following the end-of-war drought, but throughout the 1950's and 1960's it coincides with the period of rapid expansion of improved pastures (see Chapter 5) and the benefits of myxomatosis.

(ii) Most of the expansion of livestock has occurred in the form of sheep and beef cattle while dairy cattle, an important growth component up to the mid 1930's, remained almost static from 1940 to the mid 1960's when numbers began to decline.

(iii) Seasonal conditions are particularly important, and result in periodic and substantial reductions in stock numbers. The most damaging drought was in the mid 1940's when total livestock were reduced by approximately one-seventh. About three-quarters of the reduction was in sheep numbers. Other significant reductions in stock numbers

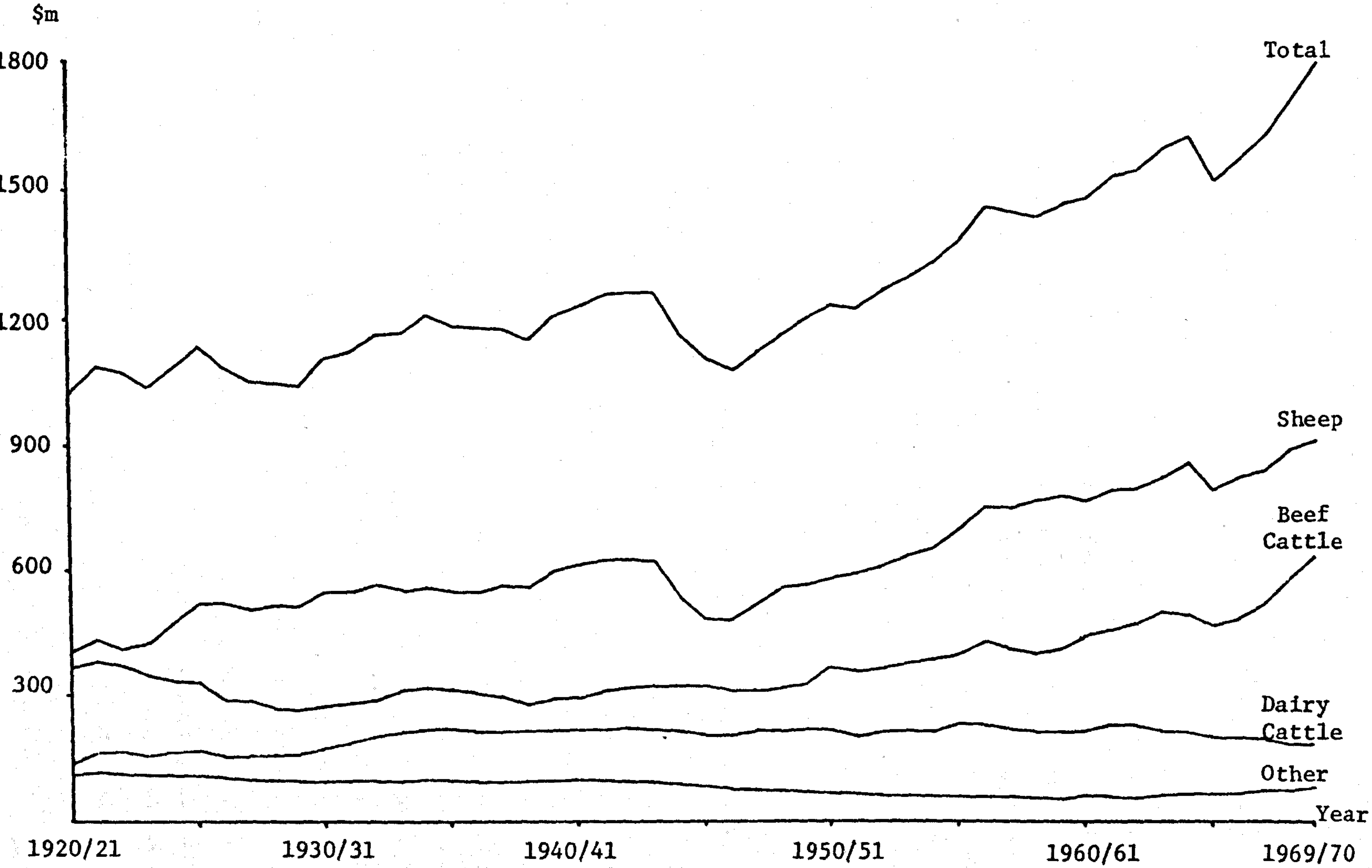

FIGURE 6.1

Livestock in Australian Agriculture, 1920-21 to 1969-70: $m, 1949-50 prices.

occurred in the mid and late 1920's, late 1950's and mid 1960's.

(iv) The detailed tables indicate the steady decline in horses throughout the whole period which is obviously the result of the substitution of tractor power for horses. Poultry and pig numbers have increased particularly through the 1960's as intensive methods of production were introduced.

The significant increases in stock numbers over the period have a number of implications which stem from the nature of this investment which can be regarded as essentially identical to the process of producing livestock output. The same resource inputs are required, and the resulting animals can be considered as an output and sold, or can be considered as an output but retained as an item of capital for use in producing output in subsequent periods. Clearly then, any additions to livestock inventories are production and should be added to measured output. Likewise, any selling off of inventories will be counted as part of output for that period whereas the actual production took place at some earlier time. Hence, decreases in inventories should be deducted from output[1]. Unless measured output is adjusted for changes in livestock inventories there will be errors in the allocation of output between time periods which leads to the unsynchronised timing of some inputs with the resultant output. With the exception of Butlin's compilations of output up to 1938-39 [3], no study has included changing livestock inventories in output, although Gruen, Campbell and Crawford [5] recommended this action in 1961. In line with the alternative procedure outlined in Chapter 2 measured inputs could be reduced by that portion used to produce additions to inventories. This latter adjustment would be most difficult and would require additions to inputs when inventories were reduced.

Gutman [6] used an alternative technique for handling a related aspect of this problem and Wilson [8] followed the same procedure.

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1 There are some added complications in the case of droughts which are considered later in this section.

This arose from Gutman's concern that the livestock included in the census count were not entirely of an investment nature. Some were merely outputs in process, being prepared for sale but not yet sold. He went on to argue that this proportion of goods in process was not stable and fluctuated between years. In an attempt to correct for this, he argued that the numbers of stock slaughtered in any year approximated the number of stock which were production rather than capital and therefore slaughterings should be deducted from the census estimate of stock numbers. The assumption here is that slaughterings take place uniformly over the whole year, and that slaughtered livestock are kept an average of one year or more. Gutman only applied this adjustment to sheep and beef cattle.

There are four points that can be raised against such an adjustment. First, Gutman is attempting to draw a fairly fine distinction between what are essentially two types of capital, the longer term type represented by breeding stock, and the shorter term type of working capital represented by goods in process including store cattle purchased for fattening. Both are components of capital used in the process of production and should be included.

Second, one can argue with the contention that slaughterings approximate the level of goods in process at the census date. For example, the number of lambs slaughtered in a year, at an age of less than one year, would far exceed the number of lambs included in the sheep inventory at census date. In addition, many of the cattle and sheep slaughtered would be culls associated with normal herd or flock replacement and could not be considered goods in process. Thus, the slaughtering adjustment is likely to be excessively large.

Third, livestock that are kept longer because of seasonal conditions provide a basis for higher output from higher carcase weight, or better quality. Capital is required to do this in the form of working capital to hold the stock longer. The converse would apply to earlier sale of livestock. If Gutman's adjustment was accurately carried out, it would imply that such additional output could be gained without any additional capital.

Four, a simple numerical example suggests that the adjustment may result in increased errors in estimating livestock capital. The three cases shown in Table 6.1 illustrate this point. Assume that the capital component (line 1) is the same in each case. In case (a), an added amount of livestock as goods in process of $20 (line 2) is included in the total inventory of $120 (line 3). If slaughterings are equal to $20 (line 4), then the Gutman adjustment performs as hoped and the capital component of livestock is accurately estimated at $100 (line 5). In case (b) assume that there is an increase in recorded inventory due to the retention of $5 of stock for an additional period. In addition, the retention of stock has reduced slaughterings by $5. In this case, the productive component of livestock capital has remained constant, the unadjusted livestock inventory suggests an increase of $5, while the adjusted inventory will indicate an increase of $10. Case (c) is the converse example of earlier selling of stock and increased slaughterings. In this case too, the adjusted inventory estimates a larger change than the unadjusted estimate. Thus, while the adjusted estimate of livestock capital is closer to the level of the capital component of the livestock inventory, there is an overestimation of the changes in this level. Thus, fluctuations in the livestock inventory could be exaggerated by using the adjustments proposed by Gutman.

For these reasons, the advantages from adjusting the livestock inventory as proposed by Gutman appear to be negligible and may even be a disadvantage on the basis of Table 6.1. No such adjustment is carried out in this study. Of more importance is the adjustment to output based on changes in the livestock inventory. This is significant, and is necessary to measure accurately rural output and correctly allocate that output to particular time periods.

TABLE 6.1

Examples of Effects of Adjusting Livestock Numbers by Slaughterings

Line	Item	Case (a) $	Case (b) $	Case (c) $
1.	Productive Capital	100	100	100
2.	Goods in Process	20	25	15
3.	Livestock Inventory	120	125	115
4.	Slaughterings	20	15	25
5.	Adjusted Livestock Capital	100	110	90

Reference was made earlier to some problems of adjusting rural output for reductions in livestock arising from drought[1]. Adjusting output for increased inventories is straightforward because all of the additional stock was produced during that period. The basis for subtracting reductions in inventories lies in some sales which have been recorded as part of output, have not been sales from current production but from stocks. It is justifiable to subtract all of the reduction in inventories if all of the reduction has been sold. But in droughts increased mortality is a major component of reduced livestock numbers along with an increase in slaughterings. Thus full deduction of the reduction in inventory does not seem justifiable.

There is an additional factor to be considered which results in the contrary view. In Chapter 8, which discusses rural output and estimates factor output, it is argued that the returns to the factors

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1 Butlin's comments on including livestock inventory changes in output do not include the aspects discussed in this paragraph [3].

of production, labour and capital, should be net of non factor expenses and the need to maintain capital intact[1]. Thus, an amount of output is set aside to cover depreciation irrespective of whether this amount is actually spent or not. In some periods such as the 1930's, capital expenditure was less than depreciation so that the capital stock actually declined. No depreciation is separately allowed in the case of livestock capital, but in many respects, loss of livestock in adverse seasons can be regarded as an irregular increase in depreciation. Some portion of output should therefore be set aside for the replacement of those (fully) depreciated livestock. This argument may be stretching the concept of depreciation beyond breaking point, but whether the term depreciation is justified or not is immaterial. A charge against output is made for the maintenance of all other capital items, so it is quite consistent to make a similar charge against output for the maintenance of livestock capital. The fact that the charge for livestock is irregular rather than the regular charge levied for other capital items makes no difference. For this reason, this study adjusts output for both increases and decreases in livestock inventories in similar fashion, and makes no distinction between a decrease because of stock selling and a decrease because of stock mortality.

6.5 References

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1 For details, see Section 8.4.

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