CHAPTER 7

CAPITAL: III - PLANT AND MACHINERY

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7.1 Introduction

This chapter provides estimates for each year of, (i) the stock of plant and machinery held on farms, (ii) the depreciation of that stock, and (iii) the gross addition to the stock. The period 1920 to 1970 was one of rapid mechanisation of agriculture. Thus, plant and machinery has been an important avenue of farmer investment which has at times been further stimulated by investment allowances and accelerated depreciation rates for taxation purposes.

Section 7.2 develops the concept of a stock model to be used as a basis for estimates of the capital stock, depreciation and gross investment. The data available for the estimates are surveyed in Section 7.3, while Section 7.4 details the estimates used in this study. These estimates are reviewed and evaluated in Section 7.5.

7.2 The Concepts

Estimates of the stock of plant and machinery can be obtained in two main ways. The first entails frequent censuses or stock takings to enumerate all the capital items held on farms. The multiplicity of machines of all makes and models suggests that this would be a massive undertaking, and probably not worth the effort. The second method is to perform a stocktake at infrequent intervals and to attempt to measure the net changes in the stock by other means. These changes would be due to additional plant being acquired, or to the removal of items from the stock at the end of their useful life. The second method is akin to that used in compiling data on the population, that is, regular censuses, plus records of net migration, births, and deaths, which enable the information on the population to be continuously updated.

Annual estimates of the stock may be made using the following model:

$$K_t = K_{t-1} + I_{t-1}$$

where K_t = capital stock in period t,

I_t = net investment in period t, and $I_t = GI_t - d\,K_t$,

d = rate of depreciation, and

GI_t = gross investment in period t.

Net investment will comprise the excess of new acquisitions over those items from the stock which were scrapped. In this case, a stocktake of existing assets only needs to be compiled at some point in time and for all other years, estimates can be calculated from information on net investment. However, the longer the estimates are removed from the last stocktake, the greater the likely errors. Thus, it is desirable that periodical stocktakes be carried out.

One aspect that can give rise to confusion is the conversion of values from current prices to constant base period prices. Where stock values are based on depreciated historical costs, it is incorrect to deflate the stock value for year t by the price index for that year[1]. The stock is composed of items purchased over the period t-n to t. Thus, the stock purchased in each year, t-i, must be deflated by the price index appropriate for that year. This requires information on the time distribution of purchases that currently make up the capital stock, and rather tedious deflation procedures[2].

The use of a stock model such as the one described above necessitates deflation of the stock only when there is a stocktake. For

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1 This is in contrast to the use of replacement values where all items are valued at depreciated replacement cost in period t prices. Simple deflation by the price index for period t will then give the correct result.

2 See Glau [19] for example.

intervening years, gross investment and depreciation in any period are deflated by the price index prior to calculation of the stock via the stock model above. That is, the opening stock is deflated to base period prices, depreciation is calculated from the deflated stock value and deducted, then gross investment is deflated and added to give the opening stock for the subsequent period.

The final aspect considered in this section is depreciation. Although depreciation may be viewed in a number of ways, the aspect relevant to this study is the using up of the capital stock in the process of production. The depreciated value should be an indication of the capacity of that capital item to provide productive services. When the item finally fails to yield any further service it is scrapped and depreciated value falls to scrap value.

Different capital items will have different patterns of depreciation which reflect the different ways in which the services they provide vary over the life of the asset. Some assets would show rapid depreciation from the outset, others may continue to provide very reliable service until the day it finally falls apart. Between these extremes, the heterogeneous group of plant and machinery used in agriculture is found.

Simplified procedures for depreciation are used in this study mainly because there is little information on real rates of depreciation on which to base detailed estimates [22]. More complex procedures could be used but there is no basis for assessing whether these models represent the real world situation any better than the simple models. The simple models considered are the straight line and diminishing balance models. The former assumes that the flow of productive services declines proportionately over the life of the asset, while the latter implies a steadily decreasing rate of decline in productive services over time.

Arguments can be advanced for either method, but in this study the diminishing balance method is preferred. One reason for this preference is the evidence that the average age of machinery was high (see Grogan and Bollen for example [20]). This may be due to shortages of new machinery, deferrment of replacement due to adverse economic circumstances or perhaps the tendency of farmers to retain old plant and machinery as stand-by capacity using it only when necessary. If the latter is the case, then even though the item is old and perhaps fully written off under straight line methods, it is still capable of providing productive services. The diminishing balance method would seem to cope with this situation more adequately than the straight line method. The diminishing balance method also has considerable computational ease when incorporated in a continuous stock model of the type described above.

7.3 Data Sources

7.3.1 Stocks of Plant and Machinery

Over the period 1909-10 to 1940-41 the Rural Industries Bulletin [6] contained estimates of the value of plant and machinery on Australian farms. The estimates excluded the value of commercial vehicles used on farms[1] and prior to 1930-31 no estimates were available for Victoria. Values for Victoria have been interpolated for the years 1920-21 to 1929-30 by assuming that Victorian values moved proportionately to N.S.W. values. This method was used by Gutman [23]. A stock series is therefore available for the 1920-21 to 1940-41 period valued at depreciated historical cost.

The procedures used by the A.B.S. in compiling the series for stocks of plant and machinery are not clear, particularly in relation to depreciation[2]. In Appendix 7A, a fairly crude check was made using

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1 Commercial vehicles are considered separately in Section 7.4.3.

2 Gutman [23, p.276] indicated that the rate varied between States, but precise information was not available.

data on gross and net investment. This resulted in an estimated straight line rate of depreciation of about 9 per cent, which could be biased upwards because of price changes. The corresponding diminishing balance rate would be higher than 9 per cent. Further evidence on depreciation rates can be obtained by using the opening stock value, and gross investment data[1]. Over the 1920-21 to 1940-41 period, a diminishing balance rate of depreciation resulted in the estimated 1940-41 stock value within 5 per cent of the A.B.S. recorded value. These findings provide some indication of the depreciation rates used in compiling the A.B.S. estimates of the value of plant and machinery on farms.

Since 1940-41, the A.B.S. has not published machinery value data but has published data on the number of various types of machines held on farms. The number of tractors on farms is available from 1920, but only since the early 1940's is data on a wider range of types of equipment such as ploughs, drills, headers and mowers available. These data can be used to estimate the value of plant and machinery stocks, but the list does not include all machinery and there are severe valuation difficulties associated with the multitude of types and makes of equipment. However, the data does include most of the main types of machines so that a selected group of machines can be used to compile an index of the stock of machines. Gutman [23] used this method to derive estimates for the 1942-43 to 1947-48 period. In Section 7.4.1 such an index is used to compile a machinery stock series for the 1942-43 to 1969-70 period.

7.3.2 Gross Expenditure on Plant and Machinery

To calculate changes in the stock of plant and machinery, net investment estimates are required. However, most information on plant and machinery expenditure does not distinguish between replacement and net additions to the stock but relates to gross additions. The gross

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1 These data are discussed in Section 7.4.2.

investment estimates can be obtained from data on imports and production of plant and machinery, or from the A.N.A. gross fixed capital expenditure estimates. These sources are discussed below.

(i) Import and machinery production data

Trade data includes the value of imported agricultural implements, machines and tractors from all sources and is available throughout the period [5]. Two aspects of the import data should be noted. The first is that from time to time, the classification system used for allocating imports to specific classes of goods has been changed, for example in 1945 and again in 1965. So far as the data allowed these changes have been taken into account in the series used in Section 7.4.2.

The second aspect is the valuation basis used for recording imports. Since 1947, the basis has been the f.o.b. value in Australian currency, which is the basis on which an ad valorem duty (if applicable) would be imposed. Prior to 1947, British currency f.o.b. values have been used [5]. So far as possible, allowance has been made for this factor to derive a consistent series over the 1920-21 to 1969-70 period.

Data on the production of agricultural implements and machines within Australia has been published in the Year Book [7][1]. This information provided both the value added and the value of output ex-factory. Since the aim is to obtain an estimate of farmer expenditure on machinery, the value of output is the relevant concept.

A number of problems arises in connection with these data. The first is the classification of factories which includes many that are predominately engaged in repair work as distinct from manufacturing operations. These small firms account for over 90 per cent of the

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1 Since 1968-69, this information is included in publications relating to the Integrated Census, see reference [7].

total number of factories, but employ only about 30 per cent of the labour force. Thus, this group would produce a relatively small proportion of the recorded value of output [8], and most of this would be repairs rather than production of new machines so that the recorded value of output estimate would overstate the value of plant and machinery. On the other hand, many of the so-called "repair" jobs contain major modifications to machines and in some cases, these small firms produce special "one-off" machines for farmers. So overall, there is likely to be some overestimation of the value of machines produced, but this is likely to be a fairly constant proportion of the value of machines produced.

A second problem involves the use of "value of output". This includes the value of all purchased components as well as value added, and creates no serious problems apart from the purchase of parts produced elsewhere in the same industry, or from imports contained within the relevant import classifications. In these two circumstances double counting will occur. The repair output discussed above is likely to contain a significant portion of parts. Further, imports of unassembled machines and tractors which are then assembled in Australia, leads to double counting as they are recorded as imported parts and as part of the value of output from Australian industry. It has not been possible to assess how important this factor is, but hopefully it is small and likely to be a fairly constant proportion of the value of output.

A third problem relates to export sales of part of the Australian output. Generally, exports have been less than 5 per cent of output [8] so this aspect has been ignored.

A fourth problem is differences between the value of imports plus domestic production, and actual sales. In some periods sales may be made from existing dealer stocks of machines and so would not be reflected in the import and production data, while at other times, some imports and production of machines may be added to dealer stocks. Thus, the import plus production data is unlikely to exactly represent

expenditure in particular years. This could be overcome by detailed analysis of dealer stocks and although some data does exist for recent years [3], these adjustments could not be carried out for the whole period covered by this study. As a result, no adjustment is made for fluctuations in dealer stocks. However, it is likely that this factor will primarily influence the timing of fluctuations in the level of investment in plant and machinery, rather than the trend or level of investment.

The above discussion points out a number of deficiencies in plant and machinery import and production data which are not easily resolved. To do so would require detailed data on imports and factory statistics and would require a substantial amount of work which is considered beyong the possibility of this study. However, this is the only data source on plant and machinery investment which spans the whole period of the study. Furthermore, most of the factors mentioned above are not likely to be such erratic disturbances as to invalidate the trends revealed by the series. There may be significant year to year errors but for the purposes of this study these would be relatively unimportant. Finally, the estimates based on these data correlate well with other estimates (see Section 7.5 and Figure 7.1) and so justify the compilation of this series.

To complete the compilation of this series two further adjustments are required. The first is to add to the imported value an allowance to cover transport costs, tariffs and dealer margins. Similarly for local production, transport costs from factory to farm and dealer margins, must be added. These adjustments estimate the on-farm price of new plant and machinery. The second adjustment relates to the proportion of new agricultural plant and machinery which is sold to non-rural users. An estimate of this amount is deducted from the estimated on-farm value of new agricultural plant and machinery. The remainder is an estimate of gross expenditure on new plant and machinery. The details of these adjustments are contained in Section 7.4.2.

(ii) A.N.A. gross fixed capital expenditure

The A.N.A. [1] estimate of gross fixed capital expenditure is the only official published estimate of investment in agriculture. Taxation statistics are the main source of information for this estimate. The estimate includes both new capital items subject to depreciation, and certain expenditures of a capital nature able to be fully written off for taxation purposes, in the year in which the expenditure was incurred (Sections 75 and 76 deductions for example). Other "improvements" type development works such as those discussed in Chapter 5, and many repairs which in fact are essentially capital expenditures, are not included as capital expenditure for tax purposes. The reasons which encourage farmers to allocate expenditure to current expenses rather than capital expenditure were discussed in Chapter 2, and the nature of many farm investments makes it possible for farmers to take advantage of this possibility. This "misallocation" means the A.N.A. "other costs" estimate is likely to be inflated by materials purchased and used for essentially capital works, and "wages paid" will include wages paid for labour used in capital works. On the other hand the A.N.A. estimate of rural gross investment will underestimate the actual level, with most of the underestimate arising from the improvements to land category of capital.

The A.N.A. estimate of gross investment will include most purchases of plant as these purchases are difficult to disguise as current expenses, most of the improvements to land where the farmer lets a contract for the work, and only the materials component of the value of investment where he builds the improvements himself. Even so, a proportion of these materials could be included as current expenses as suggested above. Thus, the A.N.A. estimate would seem to be most useful as an estimate of gross investment in plant and machinery. To obtain such an estimate, the amount of farm expenditure on other types of farm investment must be deducted. This is discussed in Section 7.4.3.

A second adjustment has been used in a number of studies [18, 19, 26, 27] which use the A.N.A. estimates. Originally proposed by Gruen [21], the adjustment relates to transfers of second-hand assets between farmers which do not involve any net addition to the capital stock. To estimate correctly the addition to the capital stock, second-hand purchases are included as part of gross capital expenditure, and asset disposals are deducted[1]. As a result, second-hand sales and purchases within the agricultural sector cancel out[2]. The A.N.A. explanatory notes [1] indicate that this procedure has been followed in the A.N.A. gross fixed capital expenditure estimate, and this was subsequently clarified in personal communication with the A.B.S. Thus, the adjustment proposed by Gruen, which reduced the A.N.A. estimate by 15 per cent, is invalid. Further, Young [27], Glau [18, 19] and Wilson [26], who made a similar adjustment have also underestimated the level of investment in the rural sector.

7.3.3 Plant and Machinery Price Index

The price index for plant and machinery was derived from two sources. The first spans the period 1920-21 to 1945-46, and was the index used by Gutman [23, p.277]. He attributes this to the N.S.W. Statistical Register [4], but a thorough check of this source reveals no such index. Subsequent communication with Gutman did not reveal any information on the source or nature of the index. A similar request to the N.S.W. Deputy Statistician evoked no response.

The use of an index for which there is no identifiable source is unsatisfactory. In this context, a check was made to ascertain whether any other indices or price data existed. The check revealed no useable data. Thus the Gutman index was reviewed to assess whether

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1 An adjustment is also made to take account of discrepancies between the depreciated value and the sale price [16].

2 Such a cancelling out would not occur in the case of sales and purchases which involve other sectors. However, these would be a small proportion of total second-hand transactions.

it conforms to the expected pattern of plant and machinery prices. The trend is quite similar to that of the improvements index but with a larger relative decline in the early 1920's. So in general, the Gutman index indicates that plant and machinery prices moved in line with other price movements in the economy, and in the absence of any better alternative price index, the Gutman index has been used.

For the period 1946-47 to 1969-70, B.A.E. indices have been used [9]. Up to 1960-61, the machinery component has been used. A revised series using a new base and grouping of items, is available for farm machinery, heavy equipment and motor cars from 1961-62. This has been used for the 1961-62 to 1969-70 period.

All three component indices have been spliced to provide an index for the whole period. This is shown in Appendix 7E.

7.4 Constant Price Estimates of Plant and Machinery

Available data makes it possible to estimate stock, gross investment and depreciation of plant and machinery from either stock data, expenditure data or a combination of both kinds of data. These alternative estimates are outlined in this section, and the review and evaluation of these alternatives is contained in Section 7.5.

7.4.1 Stock Based Estimates

The stock based series does not include commercial vehicles held on farms. The series was compiled in two parts, the first up to 1942-43, and the second for the remaining years. The period 1920-21 to 1940-41 used published value of plant and machinery data [6]. This was a similar procedure to that employed by Gutman [23], but two aspects of his estimates were unsatisfactory. First, his model confused current and constant price series. Specifically, his estimated depreciation was calculated from the current price stock value rather than the constant price stock. This meant that his model,

$$K_{t+1} = K_t - d\,K_t + GI_t$$

was in constant price terms <u>except</u> $d\,K_t$ which was in current prices. This inconsistency will result in excessive replacement when prices are falling[1] and the converse when prices are rising. The second and minor defect of Gutman's estimates is that he appeared to have overlooked subsequent revisions of the published estimates, and that his rounding off of relatively small numbers does create some small biases that are easily eliminated.

The stock level for each year in this period was compiled by obtaining an estimate of the 1920-21 stock in base period prices, and adding net investment, also in base period prices. Gutman's 1920-21 stock estimate has been used converted to 1949-50 prices. Net investment was calculated initially in current prices as,

$$It = K_{t+1} - K_t$$

using official estimates of the value of the stock of plant and machinery as described in Section 7.3.1. Because these stock values are depreciated historical cost estimates, this year to year change will represent a real change in the stock of plant and machinery. None of it will be due to revaluation of the entire stock which would be the case if depreciated replacement values were used. Net investment was then deflated to base prices and added to the base price stock, thus in base period prices,

$$K_{t+1} = K_t + I_t$$

In this way, stock estimates for the entire period were obtained in

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1 The depreciation estimate for year t is based on the depreciated original cost of the stock which was acquired when prices were higher during the years t-n to t. Exact replacement would entail deflating to constant prices using an index spanning the years t-n to t and weighted in accord with the purchase pattern in that period. But Gutman deflates by the index for year t and if this is lower than the weighted index for years t-n to t, then real replacement expenditure will exceed real depreciation.

constant prices. From this, depreciation estimates are obtained using a rate of 10 per cent. Gross investment is obtained by summing net investment and depreciation. These estimates are shown in Appendix 7B.

The period 1942-43 to 1969-70 was based on published data on the number of various types of machines on farms [6]. There is information on a wide range of machines which vary in importance from tractors which may comprise almost half of the value of the stock, to highly specialised machines such as various types of drills and harvesting machines. Rather than compile an index based on all machines, a small group of machines that represent certain important components of plant and machinery have been selected, and allocated weights. Some evidence for estimating weights might have been adduced from information on the number of farms of different types [2], but, most farms contain more than one enterprise so such evidence was of little use. Thus the following system was used:

(i) tractors were included as being generally used in all aspects of agriculture, and to represent the non-output specific machines, such as cultivating machines,

(ii) headers were included as representative of investment in grain production machinery,

(iii) milking machines were included as representative of investment in dairy farm machinery, and

(iv) shearing machines were included as representative of investment in sheep property machinery.

It is possible to argue with the items selected, but this would apply to any selected set. The above set has been selected as a basis for exploring this procedure for estimating the stock of machines.

A variety of weights was used to compile the index which proved most sensitive to the weight given to tractors which was the fastest growing item. The set of weights used in the series were 49/17/17/17 for the items (i) to (iv) above. The heavy emphasis accorded tractors

appears justifiable given that they represent about 80 per cent of all machinery imported and in most years more than one-third of the combined total of imports and Australian production of machinery. To that is added general purpose machinery to arrive at the approximate figure. The other types of machines were weighted equally to approximate the relative importance of these major enterprises in the agricultural sector.

To link the two parts of the series, estimates for the years 1941-42 and 1942-43 were based on the use of Gutman's [23] estimate of net investment in those years. This extended the published stock series to 1942-43, which was then inflated over the 1942-43 to 1969-70 period by the index of machinery calculated above. Depreciation and gross investment were then calculated from the stock series. The estimates are set out in Appendix 7B, and the stock level for the 1920-21 to 1969-70 period is shown in Figure 7.1.

7.4.2 Supply Based Estimates

These estimates are based on estimating the value of plant and machinery supplied to the rural sector. Of the three estimates this is the only one based on the same data source throughout the whole period. Like the stock based estimate, it also excludes commercial vehicles. But unlike the stock based estimate, which directly uses or estimates stock value, this estimate approaches the stock value via a gross expenditure estimate. As indicated in Section 7.3.2 a number of adjustments was needed to derive a useful series. They are discussed below and the estimates are shown in Appendix 8C.

To obtain farm gate values for purchases of plant and machinery, allowance needs to be made for the cost of transport to farming areas, and for dealer margins. This would apply to both imported and locally produced machines. Bernasek and Kubinski [8] indicated that dealer margins were 15 to 25 per cent of machine value. Butlin [14] used a 35 per cent mark-up for locally produced goods which would be at the

upper end of the range suggested by Bernasek and Kubinski after allowing 10 per cent for transport cost. This transport cost item may be somewhat too low given the distance many farms are from major ports for imports, and from the main machinery producing State, Victoria. Thus, in this study, the higher mark-up of 35 per cent is used for local production.

Imports are subject to additional transport costs from overseas, (import statistics being recorded on an f.o.b. basis) tariff charges, and importer margins. Generally, tariffs have been low, for example tariffs on tractors, which is the main imported item, have been 10 per cent or less. However, these charges in total would suggest that the mark-up for imported goods should be more than the 45 per cent used by Butlin [14] which was only 10 per cent higher than the mark-up used on local production. This study used a 50 per cent mark-up.

The described adjustments approximate the value of agricultural plant and machinery sold in Australia to all users. But, apart from tractors, no information seems to be available on non-agricultural sales of machinery. Information on tractors however extends back to 1936-37 where the pre-war indication is that virtually all imported tractors went to agriculture [17]. This evidence is used to justify allocating all imported machinery to agriculture over the 1920-21 to 1935-36 period. For the 1936-37 to 1969-70 period, an estimate of the proportion of total tractors sold to agriculture has been derived from a variety of sources [6, 17, 24, 25]. This indicates that generally 80 per cent or more have been sold to agriculture, so that over this period, all imported machinery has been adjusted by this factor. The adjustment was not applied to locally produced plant and machinery because only a small number of tractors was produced locally. The resultant series was an estimate of farmer gross expenditure on plant and machinery, the details of which are shown in Appendix 7C.

The gross expenditure series described above, was used in conjunction with the 1920-21 stock value used for the stock estimate

described in Section 7.4.1. With the opening stock and expenditure expressed in base period prices, estimates of the stock for each year of the period were obtained by using the stock model and a 10 per cent rate of depreciation. The estimates are contained in Appendix 7D, and the stock values shown in Figure 7.1.

7.4.3 Combined Stock and Supply Estimates

This estimate was designed to make use of two sources of data, namely, the published data on the value of plant and machinery held on farms up to 1940-41, and the estimate of gross fixed capital expenditure included in the A.N.A. [1] since 1948-49. In this way, the estimate would be quite directly based on published data with a minimum of manipulations. Wilson's [26] estimate of plant and machinery was of this ilk.

The estimate discussed in this section includes commercial vehicles kept on farms. The commercial vehicles are essentially goods-carrying trucks and utilities but not the family car or station wagon. These commercial vehicles perform quite important goods transporting functions between farms and other sectors as well as within farms and materially add to the productive capacity of the farm sector, thereby justifying their inclusion. Commercial vehicles have not been included in the earlier estimates because a direct comparison of the stock based estimate, and the supply based estimate was considered desirable without being encumbered with somewhat questionable estimates for vehicles.

Apart from the addition of data on vehicles, additional data used in this estimate was the A.N.A. estimates of gross fixed capital expenditure for the period 1948-49 to 1969-70. As indicated earlier, this estimate relates primarily to plant and machinery expenditure but does have a significant non-plant component. Thus, some adjustment for the non-plant component was required. The adjustment was based on gross expenditure on plant as a proportion of the gross expenditure on plant and improvements as indicated by the A.S.I.S. Since 1957-58, this ratio

was calculated from published A.S.I.S. reports [10, 11, 12, 13]. Prior to 1957-58, information compiled by Glau [19] from A.S.I.S. information was used although some doubts exist about the reliability of A.S.I.S. estimates prior to 1957-58[1]. The calculated ratios are shown in Table 7.1.

A number of reservations arise in relation to the A.S.I.S. based estimates. The first relates to the procedures used by Glau. Glau [19, p.16] used the A.S.I.S. data to classify capital expenditure according to depreciation rates of 3, 5, 10 and 15 per cent. Plant and machinery comprise most of the 10 and 15 per cent categories. He published a table showing these allocations back to 1948-49, but failed to indicate that the years 1948-49 to 1951-52, prior to the beginning of the A.S.I.S., were interpolated on the assumption that the pattern in these years was identical to the pattern indicated in 1952-53. However, 1952-53 cannot be considered a 'normal' year because it was significantly influenced by the post-wool-boom recession in the farm sector and the imposition of import licencing [15]. For example, 1951-52 farm income was 40 per cent lower than the previous year, and in 1952-53 A.N.A. gross fixed capital expenditure was 15 per cent lower than the previous year. Considering Glau's Table [19, p.16] in this context it is likely that the 23 per cent of all capital formation allocated to the 10 per cent depreciation group (most farm machinery) was only peculiar to that year and that the proportion in the late 1940's and early 1950's was nearer the 30 per cent level indicated for the years following 1952-53. In this context Glau's estimates for these early years would appear unsatisfactory, and give a misleading impression of a large swing in the composition of investment[2].

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1 This view stems from personal discussion with officers of the B.A.E.

2 The evidence suggests that the proportion of investment in plant and machinery may have been even higher than this (see Chapter 9).

TABLE 7.1

Ratio of A.S.I.S. Plant and Machinery Expenditure to Total A.S.I.S. Capital Expenditure, 1948-49 to 1969-70

Year	A.S.I.S. estimate[a]
1948-49	.54
1949-50	.54
1950-51	.54
1951-52	.54
1952-53	.54
1953-54	.57
1954-55	.59
1955-56	.59
1956-57	.57
1957-58	.61
1958-59	.71
1959-60	.70
1960-61	.76
1961-62	.74
1962-63	.77
1963-64	.84
1964-65	.73
1965-66	.71
1966-67	.77
1967-68	.72
1968-69	.79
1969-70	.69

[a] For 1948-49 to 1956-57, derived from Glau [19], sum of depreciation groups 10 and 15 per cent, and from 1957-58 to 1969-70, derived from A.S.I.S. reports [10, 11, 12, 13]. Plant and machinery expenditure includes vehicles.

A second problem with the A.S.I.S. based estimates shown in Table 7.1, is an apparent discontinuity in the series between 1957-58 and 1958-59. At this time, the ratio makes a discrete movement upwards of 0.1, while on either side of this point, the ratio is relatively stable. Glau's estimates [19] likewise indicate such a break. But Glau's data showed an additional sharp upward movement between 1959-60 and 1960-61. The late 1950's was the beginning of a substantial increase in wheat area which would be tending to increase the proportion of investment in plant and machinery. But this was only beginning and would not account for all of the observed change in the ratio of plant investment to total investment as suggested by A.S.I.S. data. Some factors associated with the collection and analysis of this data would seem to have had some influence on these results, so that the usefulness of these A.S.I.S. ratios is reduced[1].

The final consideration which detracts from the use of A.S.I.S. based estimates is the representativeness of the results for Australian agriculture as a whole. The A.S.I.S. sample is drawn from a population of between 90,000 and 100,000 farms, about half of which are classified wheat-sheep with important cropping activities. The proportion of all farms with important cropping activities is less than this[2]. To the extent that plant and machinery requirements are more strongly related to cropping than to grazing, it would suggest that the A.S.I.S. indicated trends of expenditure on plant and machinery are likely to exaggerate the trends for the whole agricultural sector. For example, from the late 1940's until the late 1950's when wheat production was declining in

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1 Some discussion with the B.A.E. has taken place, but without conclusively identifying the causes.

2 Tentative evidence to support this contention can be obtained from information on the relative areas cropped on sheep/cereal and sheep farms compared to all farms [2]. The proportion cropped on the sheep/cereal and sheep farms is about 20 per cent higher than on all farms.

importance, the A.S.I.S. would tend to indicate a lower level of capital expenditure on plant and machinery than in fact occurred. Conversely, in the 1960's when wheat was booming, the proportions for the rural sector would be overestimated.

At the beginning of this section the desire was to utilise available information on stocks of plant and machinery on farms, and the A.N.A. gross fixed capital expenditure estimates. The A.S.I.S. is the only comprehensive survey source which provides some information on the composition of capital expenditure. But the preceding discussion indicated a number of problems in determining the proportion of the A.N.A. capital expenditure estimate incurred on plant and machinery from the A.S.I.S. Thus, estimates based on these sources were likely to be suspect. As a result, a composite estimate was compiled which (i) included commercial vehicles, (ii) utilised estimates of the value of plant and machinery kept on farms over the 1920-21 to 1942-43 period, (iii) utilised information on the number of commercial vehicles held on farms over the 1942-43 to 1950-51 period, and (iv) utilised information on plant and machinery supply from Section 7.4.2.

The following describes the compilation of estimates for plant and machinery on this basis. Three sub-periods were considered. First, for the period 1920-21 to 1942-43, the stock based estimate from Section 7.4.1 was used, but with an amount added for commercial vehicles. The vehicle component was that indicated by Gutman [23, pp.277-278]. His estimate used A.B.S. data on the total number of registered commercial vehicles, and allocated one-third to the agricultural sector. The proportion was based on Victorian data which indicated approximately one-third of commercial vehicles were registered at primary producer concessional rates. The estimated number of vehicles were then valued at the base period price to obtain the constant price stock value. The vehicle value used by Gutman corresponds to a base period price for this study of $862. Calculated in this way, the vehicle stock value was added to the plant and machinery stock value from Section 7.4.1.

In the second period from 1943-44 to 1950-51 gross investment was compiled as the sum of gross investment calculated from the supply based estimates of Section 7.4.2, plus the estimated gross investment in vehicles. The latter component was based on data on the number of commercial vehicles held on farms [6]. Thus gross investment in commercial vehicles consisted of 10 per cent of the stock as depreciation, plus the intercensal increase, valued at the base period price of $862. This estimate of gross investment and the stock model described earlier provided the constant price estimates of stock of plant and machinery for this period.

For the third period from 1951-52, there was little data on vehicles kept on farms. As a result, the gross expenditure on plant and machinery including vehicles, was estimated at 1.4 times the plant and machinery expenditure derived from the supply based estimates of Section 7.4.2. The 1.4 factor was guided by the ratio of the estimated gross expenditure including vehicles to the estimate excluding vehicles for the 1943-44 to 1950-51 period, which was 1.35. Prior to 1939-40, the average for the 1930's was over 1.5. This information, and the possibility that 10 per cent depreciation of vehicles may be too low, despite the evidence of Appendix 7F, resulted in selection of the 1.4 factor. This resulted in a gross expenditure series from which the stock value of plant and machinery including vehicles, was derived. These values for the entire fifty year period are presented in Appendix 7E, and shown in Figure 7.1.

In Table 7.2, a comparison is made between the proportion of A.N.A. gross fixed capital expenditure attributed to plant and machinery as estimated above, with the proportion indicated by the A.S.I.S. data shown in Table 7.1. Over the 22 year period the average ratio indicated by the A.S.I.S. source is .02 higher which is negligible. However, the difference is much greater in the early and late parts of the period. In the early years, the A.S.I.S. estimate is lower while the converse applies in more recent years. Such a result is consistent with any

TABLE 7.2

Ratio of Plant and Machinery Expenditure to Gross Fixed Capital Expenditure, 1948-49 to 1969-70

Year	Supply Based Estimate[a]	A.S.I.S. Estimate[b]
1948-49	.54	.54
1949-50	.61	.54
1950-51	.55	.54
1951-52	.66	.54
1952-53	.60	.54
1953-54	.65	.57
1954-55	.68	.59
1955-56	.62	.59
1956-57	.54	.57
1957-58	.63	.61
1958-59	.60	.71
1959-60	.66	.70
1960-61	.64	.76
1961-62	.61	.74
1962-63	.63	.77
1963-64	.69	.84
1964-65	.79	.73
1965-66	.69	.71
1966-67	.63	.77
1967-68	.68	.72
1968-69	.68	.79
1969-70	.64	.69

[a] Supply based estimate of expenditure on plant and machinery plus an allowance for purchase of commercial vehicles, see Section 7.4.3.

[b] See Table 7.1.

tendency for the A.S.I.S. data to overemphasise the swings in plant and machinery expenditure that emanate from the changing fortunes of the wheat industry. But, the plant and machinery supply based estimates still show some redirection of expenditure consistent with the changing importance of wheat production.

One further minor aspect of Table 7.2 relates to the timing of expenditure. A comparison of the two series reveals the tendency for the A.S.I.S. peaks and troughs to precede the supply based peaks and troughs by about a year. This would tend to confirm the existence of some lags, particularly a lag in imports and domestic production responding to changes in farmer demand for plant and machinery. Thus, an increase in farmer demand would tend to be met from stocks which are subsequently rebuilt, thereby creating the lag shown in the supply-based estimate of expenditure. The problems of stock changes was alluded to in Section 7.3.2 along with the difficulty of studying this problem. In terms of the present study, this problem does not invalidate the trends indicated by the series, but care should be exercised in using the estimates to attempt to analyse precisely aspects of investment involving turning points.

7.5 Review and Evaluation

It is possible to be quite discouraged with the estimates of plant and machinery. The main negative factor is the paucity of data on all forms of farmer expenditure including plant and machinery. However, the estimates contained in this chapter are encouraging for two main reasons that appear to be more than coincidence.

First, there is a close correspondence between the stock based and supply based estimates throughout the entire period. This is particularly encouraging over the 1920-21 to 1940-41 period when stock value data is available, and suggests that the supply based estimates can be used with some confidence throughout the whole period. It may be that

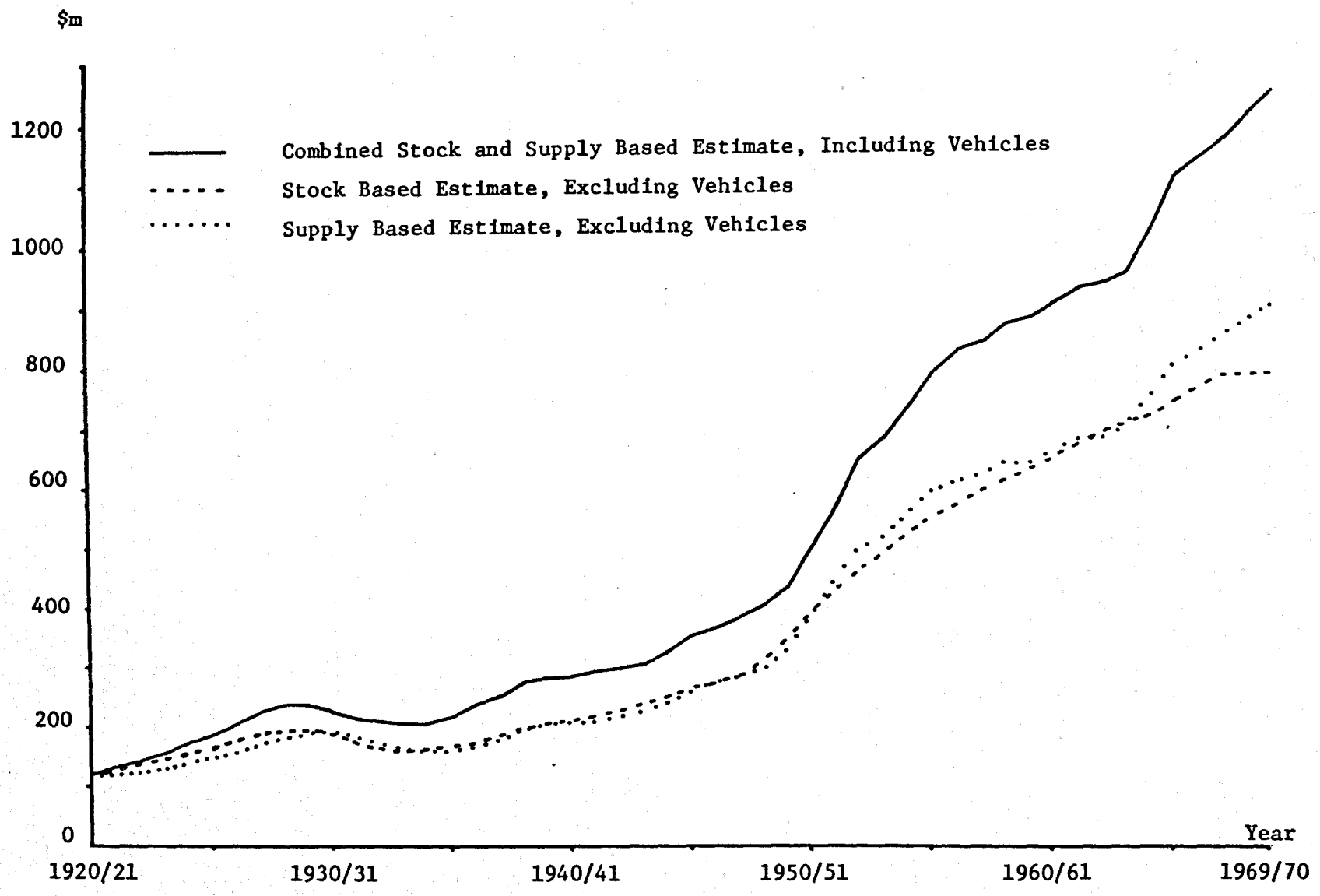

FIGURE 7.1

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

there are compensating errors which make the good results fortuitous, but Butlin [14] observed a similar satisfactory result when he studied these data for the period up to 1938-39.

The second encouraging aspect results from a comparison of the estimates for the 1950's and 1960's, with a national stock estimate derived from A.S.I.S. data. These comparisons are not easily made for reasons such as differing definitions and the representativeness of the A.S.I.S. data for Australian agriculture as a whole. By assuming that the A.S.I.S. sample is drawn from a population of farms which approximates 46 per cent of all farms in Australia[1], a national estimate of the value of plant and machinery held on farms can be made. These are shown in Table 7.3 and generally indicate that the A.S.I.S. estimate is within 10 per cent of the estimate made in this study.

The exception is the estimate for 1969-70 where some doubt can be cast on the estimate for this study, on the grounds that it is being influenced by the lags discussed above in relation to Table 7.2. That year was the beginning of the rural recession as sheep and wool prices began to slide, and wheat quotas were imposed. These factors induced a slow-down in farmer expenditure in plant and machinery which began to show in the stock based estimate (see Appendix 7B) in 1968-69, and likewide in A.S.I.S. data. However, the plant and machinery supply based estimates suggested this slow-down did not begin until 1969-70. While this does not invalidate the supply based estimates it does underline the earlier cautionary remarks about the timing of changing investment patterns. Further it would account for the increasing disparity of the two estimates shown in Table 7.3 in 1969-70[2].

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1 For this purpose, the A.B.S. number of commercial farms has been used rather than all farms [2].

2 It is interesting that in 1973-74 when farm incomes had recovered and farmers increased expenditure, that there have been shortages in machinery supply. When data becomes available, the supply based estimate is likely to again lag behind other indicators of plant and machinery investment. This would compensate for an apparent overestimate of expenditure in 1968-69 to 1969-70.

TABLE 7.3

Estimates of the Value of Plant and Machinery on Australian Farms; Selected years, $m current prices

Year	This Study[a]	A.S.I.S.[b]
1952-53	654	687
1957-58	849	832
1960-61	912	820
1963-64	968	1,020
1966-67	1,152	1,090
1969-70	1,261	1,083

[a] Combined stock and supply based estimate, Appendix 7E.

[b] Derived from A.S.I.S. reports [10, 11, 12, 13].

For the purpose of this study, the estimates discussed in Section 7.4.3 and compiled from a combination of stock and supply data are preferred. The reasons for this preference are outlined briefly below, but do not include as a reason, the inclusion of commercial vehicles in this estimate. As the discussion of the compilation of the series implies, commercial vehicles have been considered apart from other plant and machinery. As a result, the estimate for vehicles could be added onto any estimate of the non-vehicle portion of plant and machinery.

The main objective in this chapter is the derivation of an estimate of the value of the stock of plant and machinery held on farms. Thus, the preferred data is the value of stocks of plant and machinery. This is only available for the 1920-21 to 1940-41 period and does not include commercial vehicles. Unless there are substantial deficiencies in the value data, it is preferable to use that data rather than deriving value estimates from some other source. While there are some deficiencies in the value data, they do not appear sufficient to invalidate the use of these data.

For the remaining period, 1941-42 to 1969-70, there was a choice between estimates based on the number of machines, or an estimate based on the supply of machines. The latter has been preferred for three reasons. The first is that over the 1920-21 to 1940-41 period, the supply based stock estimate is close to the estimate based on stock values (see Figure 7.1). Thus, in the absence of substantial reasons to the contrary, it is expected that the supply based estimate would continue to approximate closely the value of the stock of plant and machinery post-1940-41.

Second, numbers of machines are an inadequate measure of machinery capacity when technological developments are rapid. This is highlighted by data on the number of header harvesters compared with milking and shearing machines. The latter two have steadily increased throughout

the post-war period; shearing machines in 1969-70 were 78 per cent higher than in 1949-50, in response to a 55 per cent increase in sheep numbers, and milking machines were up 47 per cent despite a 16 per cent decrease in dairy cattle over the same period. Headers show only an 8 per cent increase, despite a 92 per cent increase in wheat acreage over the 1949-50 to 1969-70 period. Thus, in the case of headers at least, the number of machines is a poor indicator of wheat harvesting capacity. However, the additional capacity arising from technological developments will be at least partially reflected in the value of machines. This will be included in the supply based estimates which are in value terms, but not in the stock series based on an index of machine numbers.

The third reason for discarding the stock index approach is related to the approximations used in compiling the index. Ideally, all machine types should be included, and each type weighted in accord to the contribution of that machine type to production. While there are reasonably adequate data on a number of machine types, a reliable basis for weighting the various types seems impossible so that arbitrary weights of questionable validity tend to be adopted.

For these reasons, the preferred estimate for the period 1941-42 to 1969-70, was the supply based estimate from Section 7.4.2. However, reference to Figure 7.1 shows that there were relatively small differences between this series and the stock based series. The difference was largest in the late 1960's and to some extent was due to increases in machinery for grain production which were poorly represented by the number of headers. Overall, the closeness of the two estimates for the 50 year period, was itself encouraging.

The data for commercial vehicles was more inadequate because only for the 1942-43 to 1950-51 period was information on the number of commercial vehicles on farms published. This data has been used where possible along with other estimates compiled by Gutman. For the years after 1950-51, expenditure on commercial vehicles has been assumed to be

proportional to expenditure on non-vehicle plant and machinery. This would appear to be the most reasonable assumption in the absence of more definite information, but there are reservations about whether expenditure on commercial vehicles has (and will) continue at the same 40 per cent level of non-vehicle plant and machinery expenditure. As indicated in Appendix 7F this presently represents more than two vehicles per commercial farm which must be near a maximum level.

The trends in stock values shown in Figure 7.1 appear as expected. There is a rising stock value through the 1920's followed by some disinvestment during the 1930's depression. From the mid-1930's the level has increased continuously. Investment in plant and machinery recovered fairly quickly following the depression, but slowed down in the first years of the War. However, major decisions in 1943 gave higher priority to machinery investment and this began a period in which machinery investment was very high. The rate of investment tapered off during the 1950's beginning with the imposition of import restrictions in 1952. Finally, machinery investment received another fillip early in the 1960's, as greater emphasis was placed on cropping. More discussion of these aspects is contained in Chapter 9.

7.6 References

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CHAPTER 8

RURAL OUTPUT

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RURAL OUTPUT

8.1 Introduction

As indicated in Chapter 2 output can be measured at several levels. These range from the concept of the gross value of farm production to the more refined concept of value added by the rural sector. It is this more refined concept of value added or the production derived from the employment of rural labour and capital that is sought for subsequent productivity analysis. Estimates of value added, or what will be termed factor output, is the objective of this Chapter. The process of compiling this estimate begins with the gross value of farm production and then proceeds to factor output by deducting the value of non-factor expenses.

8.2 The Gross Value of Farm Production

Official estimates of the gross value of farm production (hereafter referred to as gross output) have been made since the early 1900's and so span the entire period covered by this study. Some disaggregation of the estimates, at least to pastoral, agricultural, and dairying, poultry and other production, (hereafter referred to as dairying), is also available for the entire period. All of these data are published in the Value of Production Bulletin [4]. In addition to these official estimates, there has been some discussion and revision of the estimates, particularly the estimate of factor output. The important contributors have been Melville [15] and Roland Wilson [18]. Both of these were considered and used by Gutman [12] in compiling his factor output[1] estimate, while Roger Wilson [17] based his estimates on the data compiled by Melville. In this study, the Melville and Roland Wilson estimates

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[1] Gutman used the term "Net Production".

have not been used, but the more recent work of Butlin [6] has been used for the years to 1938-39, Value of Production Bulletin [4] estimates to 1947-48, and the A.N.A. [2] estimates since then.

The procedure used in compiling the official estimates of gross output is to establish the quantity of outputs produced and then to value those outputs at market prices (for a definition, see the Value of Production Bulletin [4] and for further discussion of this method, see Youngman [21]). The market prices are those pertaining in the major markets so in essence, they represent wholesale prices and not farm gate prices. To obtain the latter, deductions must be made for marketing costs[1]. This general procedure has been used in the Value of Production Bulletin since these estimates were first compiled. Many refinements have been made in the application of the method, over the years with implications for the consistency of the estimates as outlined in Chapter 2.

8.2.1 The Estimates

(i) 1920-21 to 1938-39

Butlin [6] examined the Value of Production Bulletin estimates of gross output for the years 1920-21 to 1938-39. This examination considered the disaggregated pastoral, agricultural and dairying components of production. For the period covered in this study, only the agricultural component was not adjusted by Butlin. Both the pastoral and dairying components were considered unsatisfactory for two main reasons. First, pastoral production did not include the value of livestock inventory changes in output. This point has already been discussed in this study[2]. Second, the estimates for both pastoral and dairying, included some value added by processing sectors. In the pastoral estimates, this related to the processing of skins, hides, tallow, etc. and was not a very large

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1 These are considered in Section 8.3, as part of non-factor expenses.

2 See Chapters 2 and 7.

component. However, in dairying, the amount of processing value added included in dairy production estimates is quite large as it included the production of "natural and processed commodities produced from milking cows" [6, p.124]. Butlin, therefore re-estimated dairy output so as to exclude any processing, and over the 1920-21 to 1938-39 period, his estimates are approximately 60 per cent of the Value of Production Bulletin estimates.

The detailed analysis of the official estimates of gross output by Butlin, and his re-calculation of gross output suggests that, for the 1920-21 to 1938-39 period, the official estimates should be disregarded, and Butlin's estimates used instead. Further, no such adjustments were made in the studies of Melville [15], Roland Wilson [18] and Gutman [12], so that these studies are also disregarded in compiling estimates of gross output. Thus, the gross output estimates up to 1938-39 are those of Butlin, with only two adjustments. The first was to exclude forestry, fisheries and trapping. The second was to use the estimates of changes in livestock inventories contained in Chapter 6 of this study rather than the estimates of Butlin. This is for two reasons. First, the adjustment to output for changing livestock inventories will be consistent with the livestock inventory estimates used as part of the capital stock. Second, the livestock inventory estimates in this study include horses and poultry whereas Butlin's estimates do not. A check of the two estimates of the change in livestock inventory shows close correspondence in the direction of change, and, after allowing for price differences, the magnitude of the changes is similar.

(ii) 1939-40 to 1947-48

In the period since 1939-40, estimates of gross output must rely on the Value of Production Bulletin [4]. The work of Butlin has not been extended beyond 1938-39. However, in 1943-44 and on, two official estimates of gross output were compiled; a revised estimate designed to improve the allocation of value added in processing pastoral and dairy products, and the old estimates which were retained for comparative

purposes [4, 1943-44 issue, p.66]. From 1943-44 on, the official estimates should be reasonably comparable to those of Butlin but for the years 1939-40 to 1942-43, a case exists for some adjustment to the official estimates.

Consideration of the official estimates and those of Butlin does not provide a clear basis for an adjustment. In 1938-39, Butlin adjusted pastoral production up by $20m (excluding the livestock inventory change) and dairying down by $44m [6, pp.54, 128]. In 1943-44, the revised official estimates have revised dairying only slightly, but pastoral output is reduced by $27m. The impression that is created by these adjustments is confusing and certainly provides no clear basis for an adjustment to the official estimates for the years 1939-40 to 1942-43. The suspicion is that the series should be adjusted downwards, but by how much? Rather than guess at an adjustment it was decided to use the official estimates without adjustment[1]. Thus there is likely to be some discontinuity in the gross output series in the early 1940's which should be borne in mind in later analysis. However, from 1943-44 to 1947-48, the estimates appeared to be consistent.

(iii) 1948-49 to 1969-70

From 1948-49, the estimate of gross output has been taken from the A.N.A. [2]. Essentially these estimates are identical to those in the Value of Production Bulletin. A comparison reveals only very minor differences which most likely arise because of subsequent revisions to earlier estimates. The A.N.A. estimates have been preferred only because this is also the source of the non-factor expenses estimates. By drawing

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1 It should be noted that this is one inconsistency in the series that is able to be detected. Other inconsistencies in this and other series, and arising from factors such as changing census dates, changing methods of collection and analysis etc, may be equally important yet not apparent in the estimates. These impressions were obtained from lengthy personal discussion with officers of the A.B.S.

both gross output and non-factor expenses from the same source, both series will correspond in terms of all subsequent revisions to the estimates.

To complete the estimate of gross output, the change in livestock inventories is added. This component is derived from the estimates of livestock capital reported in Chapter 6. These inventory changes are estimated in 1949-50 prices. For completeness the data included in Appendix 8A shows the livestock inventory change in current prices. These were estimated by deflating the constant price estimates by the agricultural price index discussed below.

The complete series for gross output is detailed in Appendix 8A in both current and 1949-50 prices. The index used to deflate the gross output series is also included in Appendix 8A. This index was derived from the Value of Production Bulletin [4], for the period from 1920-21 to 1958-59. Over this period the index consists of two spliced indices covering different periods with different weights. The first period up to 1935-36 used weights in accord with the output pattern in the years 1923-24 to 1927-28. Since 1935-36, the weights relate to the output pattern in the years 1946-47 to 1950-51. Early in 1974, the A.B.S. published a revised index for rural output prices extending back to 1959-60 [4]. A revised set of weights was used which corresponded to the structure of production in the years 1968-69 to 1970-71. This revised index was used for the years 1959-60 to 1969-70. Thus, some discontinuities in this index may occur between 1935-36 and 1936-37 and between 1958-59 and 1959-60, but they are likely to be quite small.

8.2.2 Discussion of the estimates

The gross output series in constant 1949-50 prices is shown in Figure 8.1. Three fairly distinct phases can be seen in this series. First, throughout the 1920's and into the early 1930's, gross output grew steadily, only interrupted by unfavourable years. These occurred particularly in the years 1922-23 to 1923-24 and 1926-27 to 1929-30 and

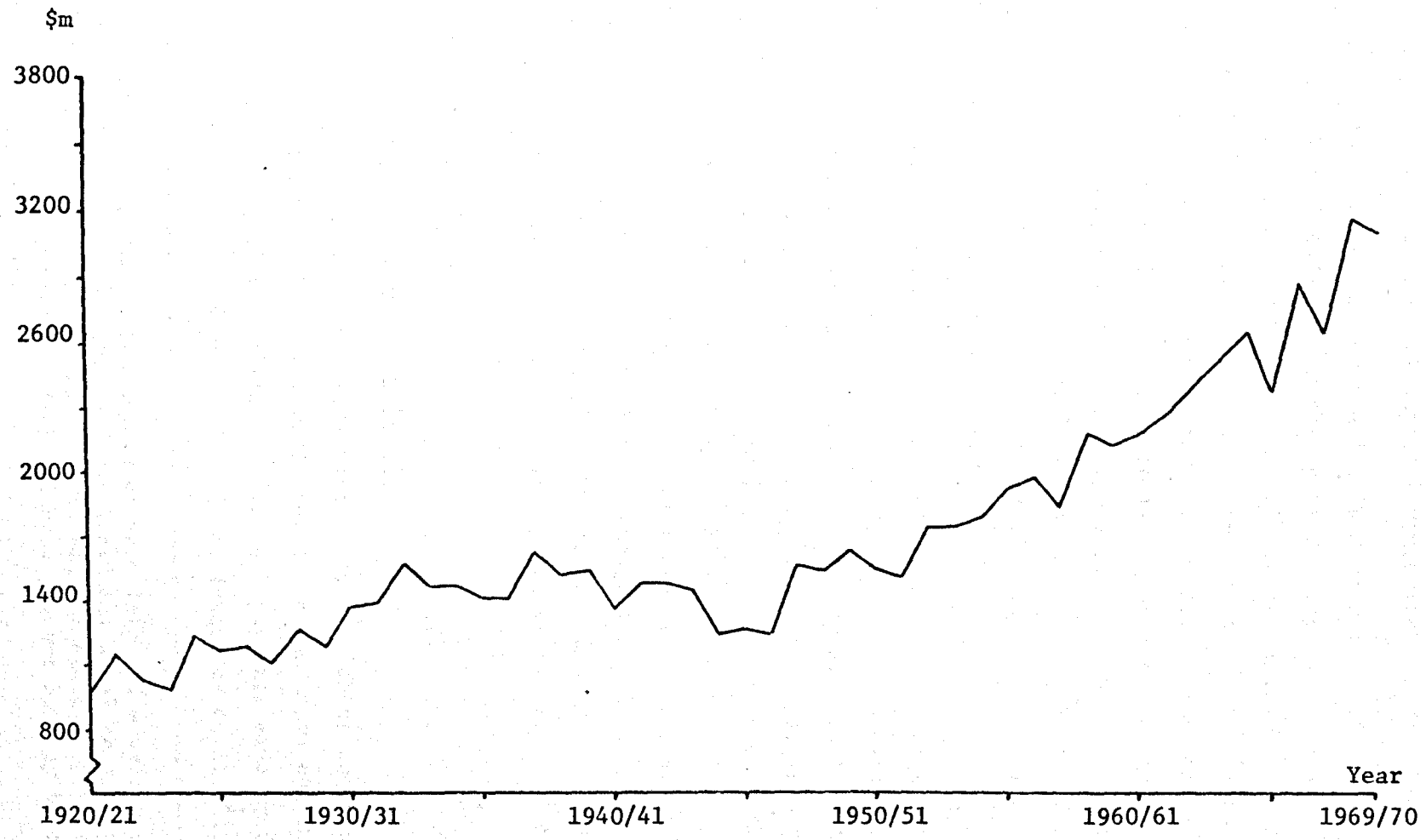

FIGURE 8.1

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

show up as years of decreased livestock inventories and low wheat yields.

The second phase follows the 1930's depression and carries through to the late 1940's. Over this period gross output was barely able to maintain the existing level and culminated in a substantial fall in the years 1944-45 to 1946-47. These mid-40's years were years of severe drought as is amply demonstrated by low wheat yields and substantial reductions in livestock inventories. The trend in gross output in this period is symptomatic of the general running down of the rural sector, such as low investment and little increase in the use of purchased inputs generally, which occurred as a result of the depression and the emergency conditions of the war period.

The third phase began with the post-drought recovery and has continued since. For the first decade up to the mid 1950's, the increase in output was at about the same rate as in the 1920's. But from the late 1950's on, gross output has shown a tendency to increase at an accelerating rate. Once again, the impact of seasonal conditions is clearly evident, particularly in 1957-58, 1965-66, 1967-68 and to a lesser extent in 1951-52. A more detailed discussion of these trends and the relationship to input levels and technological change is contained in Part III of this study. In the meantime, attention is now directed to the estimation of purchased non-factor inputs used by the rural sector.

8.3 Non-Factor Expenses

8.3.1 The Concept and Data Sources

Non-factor expenses are essentially the non-labour and non-capital costs of production and closely relate to the terms current or running expenses. This item should include all payments made by farmers that are not allocated as payments for either labour or capital[1]. On

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1 In this way all payments for inputs of materials and services used in production will be accounted for. There may still be some misallocations of payments between categories, for example, payments for management services should be a labour payment but may be included as a non-factor expense.

this basis, the A.N.A. estimates of non-factor expenses, or costs of production seem to be the most appropriate. Drawing on the A.N.A. "Definitions and Descriptions of Items" [2] the components in what is termed production costs "include all costs incurred in current production but excluding net rent and interest paid. (In more detail it includes)... marketing costs ..... (and) other costs includ(ing) indirect taxes, fertilisers, fuel, costs associated with inter-farm transfers of livestock and fodder, maintenance and other miscellaneous items." In further personal correspondence with the A.B.S., it was made clear that items such as accountancy, banking, postal and management services are included.

The A.N.A. data on costs is highly aggregated, and distinguish only marketing costs, (these would be incurred between the farm gate and the wholesale market), seed and fodder, and other costs. Further, these estimates are not disaggregated between the main components of rural production, namely agricultural, pastoral and dairying. In 1961, Gruen, Campbell and Crawford [11] lamented the lack of more detailed data on farm costs and a proposal for a sample survey of farmers to provide this (and other) financial information received a favourable reaction from the Commonwealth Statistician of the time [1]. Some difficulties of this approach were discussed by Juhasz and Hillsdon [14], but recently, such an Agricultural Finance Survey has begun. However only limited results are available from this survey and for years later than 1969-70. Thus, this source has not been used in this study but will provide a better basis for future analysis of all aspects pertaining to farm finance.

Detailed disaggregated data on farm costs are available from farm surveys particularly those carried out by the B.A.E., and some individual surveys such as that of Campbell and Archer [7]. But to compile a set of cost estimates using these sources is a very large task and major problems are encountered in using surveys which are to some extent ad hoc in frequency and industries covered. Further, the

cost data does not clearly distinguish between capital and current expenditures. Further elaboration of these and other problems can be found in Youngman [21] and Juhasz and Hillsdon [14] who compiled farm income estimates using both taxation and B.A.E. farm survey sources. These studies do provide some additional data on farm costs both by cost components and by industry, but in aggregate, they do not differ markedly from the estimates included in the A.N.A. Because these separate estimates are available for only a few years, they have not been used in this study.

The concept of non-factor expenses used in this study closely follows A.N.A. definitions [2]. This definition differs substantially from that used in the Value of Production Bulletin [4]. In that bulletin, marketing costs are identical to the A.N.A. marketing costs, but the remaining costs that are included are entirely materials. Termed the "Value of Materials Used in Process of Production" it includes "power, power kerosene, petrol and other oils, seed used, fodder consumed by farm stock, manures, dips and sprays and other selected costs of a similar nature". This Value of Production Bulletin definition excludes in particular all of the service type costs such as banking and postal charges. However, it is clear that these service type costs are essential to the running of the farm business and are legitimate expenses. Further, in attempting to estimate factor output, or the amount available for payments to factor inputs, labour and capital, all farm business expenses must be charged against farm output. Failure to do this will result in the allocation of portion of farm output to both the payment of expenses, and as a reward to labour and capital used in production.

Three further points in relation to the treatment of non-factor expenses are relevant. First, it is possible to regard these items as inputs in the same way as labour and capital are considered inputs. When items such as managerial and extension service payment are included, this reinforces the case for considering these payments as an input. Young [20] analysed technological change on this basis identifying three major

inputs, labour, capital and intermediate inputs. The present study recognises these considerations, and the final chapter includes the suggestion that further research in this and other directions is required. For the present study, the assumptions of constant returns to scale and optimal resource use are invoked[1]. On this basis, an amount of output equivalent to expenditure on non-factor expenses is allocated as the contribution to production of non-factor expenses.

The second point recalls the discussion in Chapter 2 relating to on-farm capital production. Part of this capital creation uses materials that are included in non-factor expenses. Non-factor expenses that are used in capital formation will therefore have effects on production in periods subsequent to that period in which the expenditure was incurred, and so some allowance should be made for this aspect. In Chapter 9 an attempt is made to estimate the aggregate amount of materials which are used for capital production. Using this estimate it is possible to carry out the adjustment, as outlined in Chapter 2, which attributes the materials used in capital production to capital investment.

The alternative possibility outlined in Chapter 2, is to add on-farm capital production to gross output, and to deduct non-factor expenses, without any adjustment, to obtain factor output. Estimates along these lines are contained in Chapter 9.

The third point relates to the timing aspects of expenditure and its related output. The use of the July 1st to June 30th year for reporting financial statistics means that for many activities there is some outlay on inputs in year t, but the resultant output is recorded in year t + 1. In Australia, this is particularly important for autumn sown grain crops such as wheat. For livestock activities this problem is likely to be less severe because of a wider distribution of expenditure throughout the whole year, while shearing expenses will generally

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1 This was outlined in Chapter 2, and supported by evidence in Appendix 2A.

coincide with the year in which wool production is recorded. Overall, this is likely to cause some distortion as the relative importance of grain crops to livestock changes, for example. But because the resultant impact on costs is unknown in the absence of detailed cost data, no adjustments are made in this study.

Each of the above points raises aspects involved in any refinement of the series for non-factor expenses. In quantitative terms, the most important is likely to be the second which relates to non-factor expenses including materials used in capital production. This is the only refinement attempted in this study.

8.3.2 The Estimates

In estimating non-factor expenses, three time periods are considered. The first from 1920-21 to 1938-39 is based on Butlin's estimates [6], the second from 1948-49 to 1969-70 uses A.N.A. estimates [2], while the third period covering the years 1939-40 to 1947-48, are interpolated. These are considered in turn, while the detailed estimates appear in Appendix 8B.

(i) 1920-21 to 1938-39

In this period, Value of Production Bulletin estimates are available for the rural sector as a whole only from 1933-34, and for the agricultural component from 1926-27. Furthermore, the official estimates employ the more restricted definition of non-factor expenses. Butlin has estimated non-factor expenses for each of the rural output components, agriculture, pastoral and dairying. A variety of data sources were used including the official estimates, but these were supplemented by station records, reports of transport authorities, etc.

In the sense that they are more complete, Butlin's estimates are superior. His estimates are based on a wider definition of non-factor expenses than the Value of Production Bulletin estimates. This results in his estimates being approximately 10 per cent above the

official estimates over the 1933-34 to 1938-39 period when the latter estimates are available. Using Butlin's estimates of non-factor expenses means that estimates of both gross output and non-factor expenses are derived from the same source. This should promote the consistency of the estimates.

(ii) 1948-49 to 1969-70

Throughout this period, both the A.N.A. [2] and the Value of Production Bulletin [4] estimates are available. As explained earlier, the wider definition of expenses adopted for the A.N.A. estimates makes that source appropriate for this study and it has been used for these years[1]. These estimates draw heavily on taxation data so that it is appropriate to refer back to Chapter 2 which discussed possible biases in taxation data. Despite the reservations surrounding taxation based estimates, these are considered superior to those estimates in the Value of Production Bulletin.

Only one adjustment had to be made to the A.N.A. data. Over the 1948-49 to 1958-59 period, net rent and interest paid by farmers was included in the other costs component of expenses. These are payments to capital and therefore should not be included in non-factor expenses. For the seven years beginning in 1959-60, the A.N.A. provided two estimates of other costs for the rural sector, with and without rent and interest paid. It was possible to establish that rent and interest paid by farmers was very close to the estimate of rent, interest and royalties paid by primary industry[2] for these seven years. This provided the justification for deducting rent, interest and royalties paid by primary industry from the A.N.A. estimate of non-factor expenses. This adjustment was made for the years 1948-49 to 1958-59.

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1 Over this period the A.N.A. estimate averages 1.7 times the Production Bulletin estimate, but tends downward from around 1.8 times in the early 1950's, to near 1.6 times in the late 1960's.

2 Primary industry does not include mining and quarrying, so the royalties component was small.

(iii) 1939-40 to 1947-48

In this period the only estimate of non-factor expenses is provided by the Value of Production Bulletin [4]. This estimate has already been rejected because it only includes selected costs. An attempt has been made to interpolate a series for these years to link the estimates of Butlin to the A.N.A. estimates.

The interpolated series is based on the ratio of these expenses to gross output[1]. This ratio is relatively constant with a tendency to be lower in years of high output and higher in years of low output. Apart from these fluctuations there are trends in the ratio; upwards through the 1920's, lower in the mid-1930's and rising again by 1938-39, while the ratio is climbing throughout the remaining two decades to 1969-70. The interpolated series is based on establishing this ratio for 1938-39, the last year for which Butlin's estimates are available, and for 1948-49, the first year in which A.N.A. estimates are available. Rather than use specific years, and noting the tendency of the ratio to fluctuate with seasonal conditions, a three year moving average of gross output was employed. In 1938-39, the ratio of non-factor expenses to average gross output was 0.28. A similar calculation indicated the ratio in 1948-49 was 0.31. For the intervening years it was assumed that the ratio increased linearly from 0.28 to 0.31. This ratio was then applied to the three year moving average of gross output to estimate non-factor expenses. When the ratio of non-factor expenses to gross output was calculated for individual years, the observed tendency for the ratio to be high in years of low production and low for years of high production also occurred in these interpolated estimates.

The interpolated estimates of non-factor expenses appear satisfactory on two counts. First, there is a relatively slow increase from 1938-39 until the end of the war with sharp increases in the years

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1 For this calculation, gross output does not include changes in livestock inventories. The ratios are shown in Appendix 8B.

1946-47 to 1948-49. This would be consistent with the constraints of the war period, the relaxation of these constraints following the war and the effects of the mid-1940's drought. Some increase was observed during the war period but this was expected given the increases in output that occurred in these years. Second, the trends described correspond fairly well with those of the Value of Production Bulletin series. The only major difference is a small fall in the Value of Production Bulletin estimates over the 1938-39 to 1940-41 period while the interpolated series shows a small rise.

The estimates of non-factor expenses are detailed in Appendix 8B in both current prices and in 1949-50 prices. The index used to deflate the series is also included in Appendix 8B, and is derived from two sources. For the years 1920-21 to 1944-45, the index is the same as that described in Section 5.4 for deflating improvements to land, that is, an equal weights index of wholesale prices of chemicals, building materials and metals and coal plus wages (see Appendix 5F). The justification for this is that the improvements price index includes components similar to items of non-factor expenses so it is unlikely that the price trend for a basket of non-factor expenses would be markedly different to the assumed basket of inputs used for improvements. For the years from 1945-46, the B.A.E. Prices Paid Index [5] has been used. As the definition of non-factor expenses is very wide in terms of the components included, a sub-sector of the B.A.E. index was considered inappropriate, hence the index of all prices paid was adopted.

8.3.3 Discussion of the Estimates

The non-factor expenses series in 1949-50 prices is shown in Figure 8.2. During the 1920's, non-factor expenses increased fairly rapidly but fell sharply at the end of the decade under the influence of drought and rapidly falling agricultural prices. Low levels of expenditure on this item continued until the post-war period with a slow increase noticeable from the mid-1930's. A more rapid increase

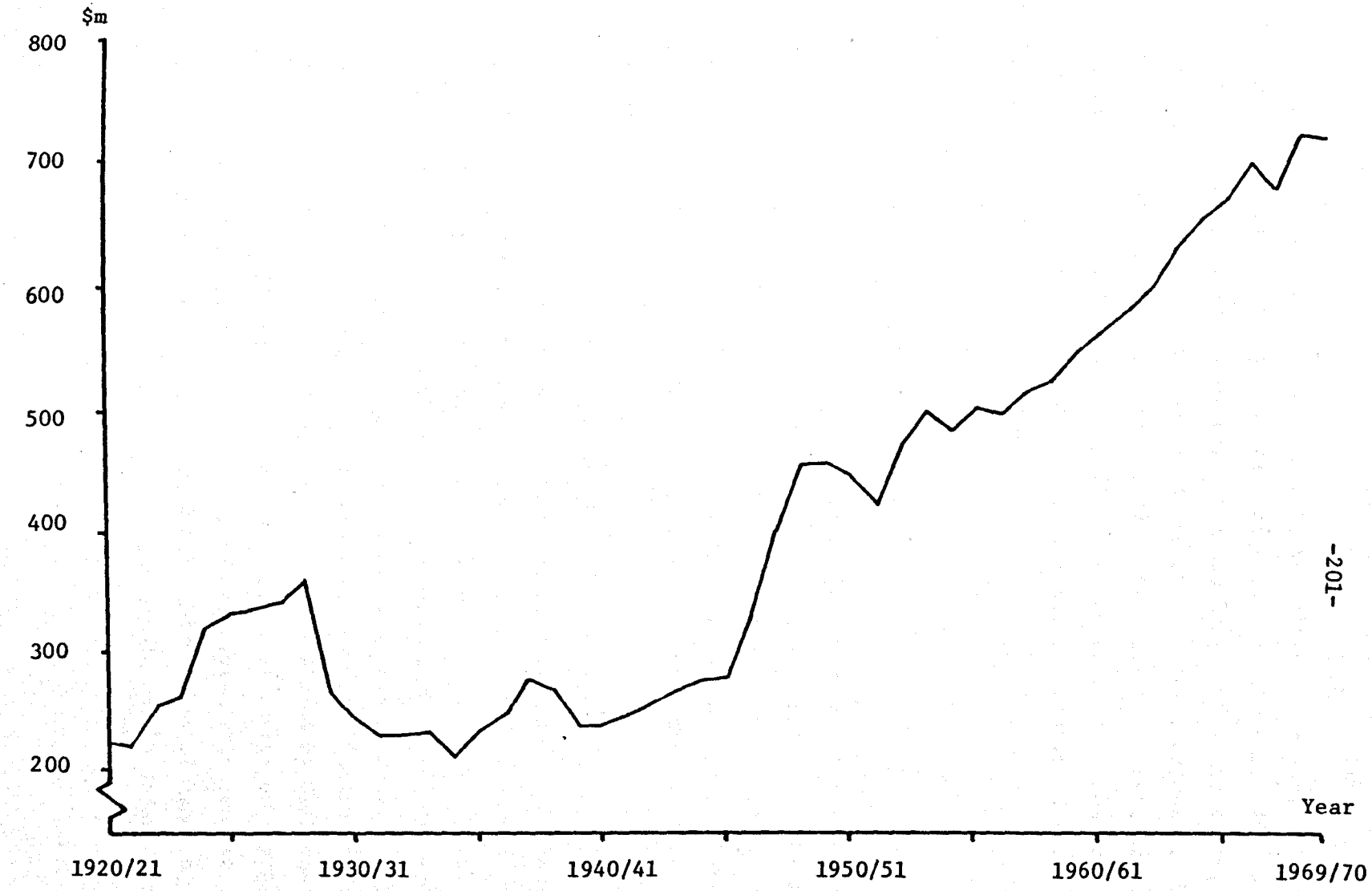

FIGURE 8.2

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

in non-factor expenses has occurred in the post-war period. There was a noticeable slackening in the rate of growth in the early 1950's following the post-war recovery. From the late 1950's and through the 1960's, there has been a rapid increase in non-factor expenses. Finally, the series does show a high degree of instability which reflects the ability of farmers to vary expenditure on these items in response to changes in their economic situation. Further discussion of these aspects is contained in Chapter 9.

8.4 Factor Output

8.4.1 The Estimates

This last series to be estimated is a measure of value added in the rural sector by the employment of labour and capital. In this way, factor output also represents the amount available for payments to the factors of production, labour and capital. This amount is derived as the gross value of farm production, less non-factor expenses, less depreciation.

The deduction for depreciation requires some explanation as it is not a cost of the same nature as non-factor expenses. Further, there are alternative ways of handling the depreciation aspect such as that used by Young [20]. In essence, Young uses data on capital investment to calculate an annual service flow from capital which he uses as a measure of capital input. This method evolves from formulations proposed by Gruen [10] and Glau [8] to estimate the depreciation component of this service flow, and from formulations developed by Griliches [9] and Yotopolous [19] which incorporate an interest charge on capital. Thus the capital service flow is composed of depreciation and an interest charge on the capital stock. If this method of handling capital input is employed, then depreciation should not be deducted to arrive at an estimate for factor output.

The service flow approach to measuring capital input is a useful refinement in the analysis of production and technological change. This method can be employed using the data as compiled in this study, but for reasons outlined elsewhere[1], the simpler method using the capital stock concept is adopted in this study.

By using the stock approach, it is necessary to deduct depreciation from gross output to obtain factor output. The reason for this is that when capital items are acquired, no charge is made against output at that time. A charge is made against output over the life of the asset. This charge is equivalent to depreciation and is designed to allocate sufficient output to maintain the capital stock. If such an allocation was not made, then it would imply a run-down of the capital stock equivalent to the amount of depreciation, and this running-down would be used to inflate factor output, and payments to labour and capital. Hence, an amount of output is allocated to cover depreciation of the capital stock.

The deduction of amounts from gross output equivalent to the sum of non-factor expenses and depreciation (referred to as deductions) is not complicated in current price terms. However, care is needed to ensure that correct deflators are employed to estimate factor output in constant prices. This was detailed in Hussey [13] and Wilson [17] where the important aspect is to deflate the deductions by the output price index rather than the price index pertaining to those deductions. This ensures that the current value of output will be equivalent to the current value of the deductions.

A simple example illustrates this point. Assume gross output is $5,000, and deductions are $1,000, both in current prices, and the price index is 150 for output and 200 for deductions. Thus, in constant prices, gross output is $3,333, and deductions $500. If $500 is allocated from gross output, then in current prices, this will be valued at

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1 Chapter 10.

$750 which will fail to cover the current value of deductions. Deflating the deductions by the output price index, and allocating this amount from gross output will result in $667 being allocated in constant price terms. When this is expressed in current prices the value is $1,000 which exactly equals the current price value of the deductions. Hence the justification for deflating the deductions by the output price ratio. The calculation of factor output on this basis is shown in Appendix 8C and factor output is shown in Figure 8.3.

8.4.2 Discussion of the Estimates

Consideration of the factor output series reveals the same general trends as in the gross output series but with some qualifications. In particular, the factor output series highlights the relatively poor performance of the rural sector in the 1920's due particularly to the large number of unfavourable seasons. However the period was one of relative prosperity, at least compared to the 1930's, while public investment in rural development was at a high level [16]. Finally, reference to Figure 8.2 indicates rapidly increasing expenditure on non-factor expenses. The detailed tables in Butlin [6] indicate a high level of expenditure on fodders in particular which again reflect the unfavourable seasons of the 1920's.

In contrast to the 1920's, the 1930's show a relatively high level of factor output. This was aided by a number of factors including an increased availability of labour, the realization of many benefits stemming from development during the 1920's, sharply reduced expenditure on non-factor expenses and generally better seasons. However, the improved performance was temporary and by the late 1930's, the effects of curtailed outlays on investment and non-factor expenses manifested themselves in declining factor output which culminated in the 1944-46 drought.

The post-war recovery was rapid but there was little further improvement during the 1950's. Factor output only began to show a

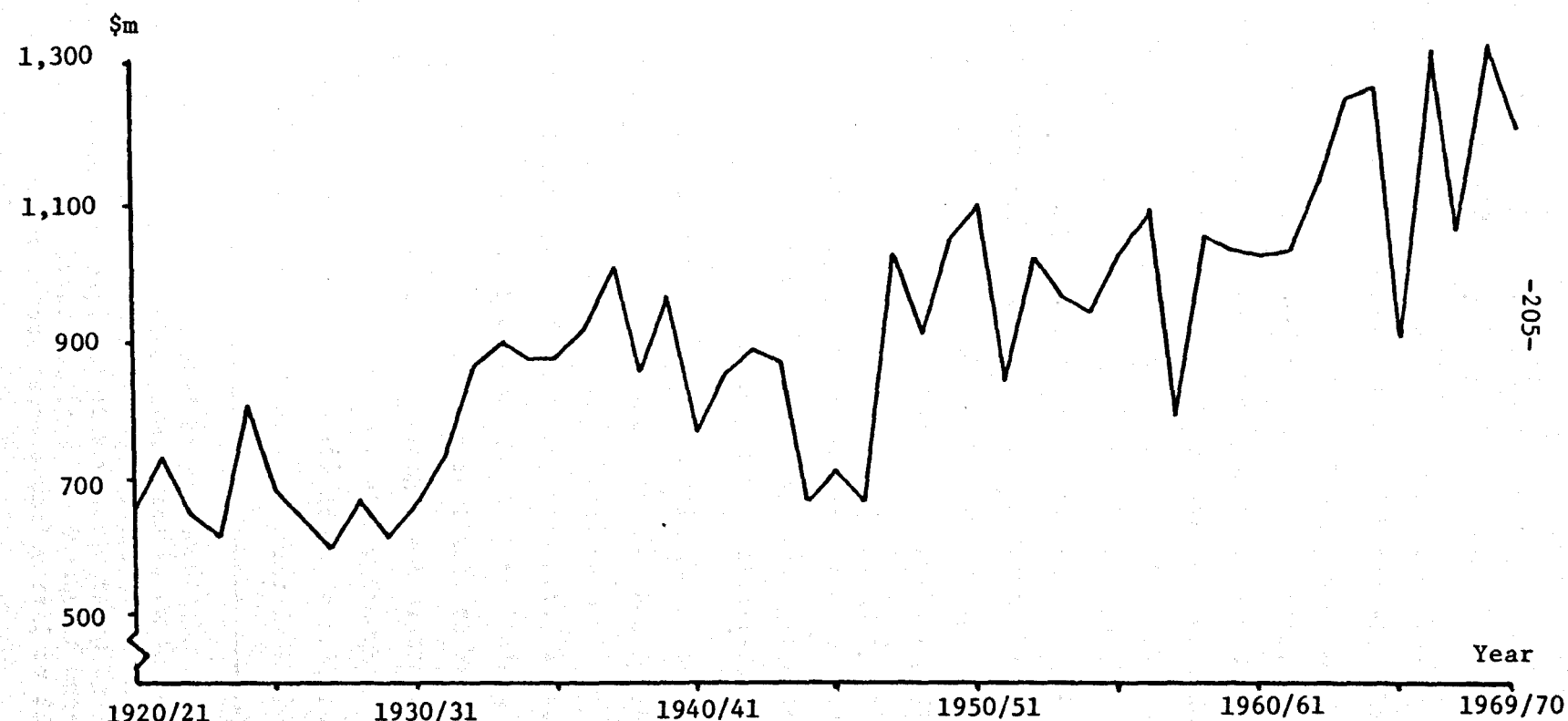

FIGURE 8.3

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

definite increasing trend during the 1960's.

The most noticeable aspect of the factor output series is the manner in which fluctuations in rural output are highlighted. What are relatively small changes in gross output become quite dramatic changes in factor output. There are several reasons for this. First, there are certain components of the deductions which are quite insensitive to changes in gross output. The most important item of this nature is depreciation. Second, there are other cost items that are likely to vary inversely with output, particularly when output falls due to drought. Expenditure on fodder and the transport of stock to agistment are obvious examples. Third, there are important lags in expenditure which can be important. Further, some of the items included in non-factor expenses can be considered optional expenditures, or may be deferred by the farmer. For example, expenditures on fertilizer and chemicals may be reduced, while repair and maintenance work and pest destruction can be deferred. As a result, some important expenditures are related to farm income levels, but usually with a time lag.

For the above reasons, it is possible that in the early period of a drought, expenditure is at least maintained and may even by higher as these expenditures, continue to be made from pre-drought income, while there are additional outlays on fodder and transport. This, combined with reduced output due to the drought, will result in a sharp reduction in factor output. The converse is likely to arise in the first post-drought year as output rises strongly yet expenditure lags behind and remains low due to the influence of low drought incomes. In terms of Figure 8.3, this is best shown by the dramatic fall in factor output in 1944-45, with an even more dramatic rise in 1947-48[1].

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1 The steepness of this rise is accentuated by the deduction of non-factor expenses deflated by the agricultural price index (as explained earlier in this section). Non-factor expenses deflated by the B.A.E. index of prices paid rose strongly, but this was countered by a 32 per cent rise in rural output prices so that the amount of non-factor expenses expressed in value of output terms actually fell by $23.6m in 1947-48 (see Appendix 8C).

The final comment relates to the smaller relative increase in factor output over the 50 year period than gross output. Gross output increased 3.1 times yet factor output failed to double, only rising 1.8 times. This arises because of the much faster increases in deductions which increased 5.8 times. Both the non-factor expenses and depreciation components shared this increase.

8.5 Concluding Comments

In terms of the availability of official data, the estimates contained in this chapter are more soundly based than most other series in this part. Some deficiencies and inconsistencies have been discussed. The most doubtful estimate is that of depreciation, which is important in calculating factor output, so that most reservations would apply to the factor output series. For this reason, Chapter 10 includes a check on the sensitivity of the estimates of technological change to the calculated level of depreciation.

This chapter concludes the conventional compilation and analysis of the component series on an individual basis. In Part III, the component series are brought together for further analysis and discussion.

8.6 References

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