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ASSESSING SOME EFFECTS OF INFLATION ON THE AGRICULTURAL SECTOR*

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The time pattern of effects of inflation on prices received, prices paid, asset returns, and real incomes of different members of the agricultural sector is described. In the long run it is argued that inflation will have very small, if any, effects on relative prices or real incomes. For the short run, which may be several years, it is likely that some prices will rise more slowly than others and cause income losses. Included in the group of losers are producers of export products.

Inflation is an important feature of the contemporary economic environment and one which is of concern to the agricultural sector. In many countries, including Australia and New Zealand, general price indexes rose by 10 or more percentage points per annum during the past decade. It is likely that inflation will continue. In recent years numerous politicians and commentators have referred to and discussed some of the effects of inflation on the agricultural sector.¹ In general they have concluded that the effects are detrimental, principally because inflation increases costs. It is argued here that inflation also affects prices received and that both should be considered in assessing effects on incomes.

A framework for analysing the effects of inflation on commodity prices received, input prices paid, asset prices, and real incomes earned by different members of the agricultural sector is set out. Particular attention is given to the time pattern of relative price changes. The aim is to isolate those effects which can be attributed to inflation from those which are associated with real changes such as economic growth. Most attention is given to effects on the sector as an aggregate; a discussion of important intrasectoral effects is left for another day. In addition to a descriptive analysis, I make some observations on the choice of a policy stance by the agricultural policymakers on economy-wide policies to influence inflation and, more generally, the macroeconomic health of the economy.

Development of the paper proceeds through four stages. To set the scene, key features of the agricultural sector which are important factors influencing the analysis of the effects of inflation are described. In the following section three types of models to assess the effects of inflation on commodity prices and input costs are described and evaluated: a

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¹ Some examples are: Mr. P. Nixon in his opening speech of the 1981 National Outlook Conference; *Farm Focus* which is a policy statement by the National Farmers Federation (1980); Annual Meetings of the American Agricultural Economics Association in 1971 and 1979, including papers by Brandow (1971), Ruttan (1979) and Robinson (1979), and papers addressed to the Australian situation by Miller (1976) and Smith and Smith (1978).

general equilibrium Walrasian model which focuses on the long-run situation; single commodity models which emphasise the distinction between the effects of inflation on traded and on non-traded goods and services in the short run; and a purchasing power parity model where the longer-run ramifications of different rates of inflation among countries and exchange rate adjustments are considered. An assessment of the effects of inflation on the returns to different monetary and physical assets is then presented. In the final section the discussion is drawn together to assess whether members of the agricultural sector gain or lose from inflation.

Agriculture in the Economy

When discussing the effects of inflation on the agricultural sector, it is worth noting that agriculture involves a number of interdependent activities; it is highly integrated with and affected by the rest of the economy; it is dependent on export markets for a large proportion of sales and to a lesser extent on imported inputs; and resource use and institutional peculiarities influence prices and incomes. These characteristics are illustrated with Australian data.

The modern agricultural sector consists of a number of highly specialised industries in which goods pass through a number of intermediate stages before reaching the final consumer. Several industries provide a diversity of items of capital equipment (e.g. tractors and buildings), material inputs (e.g. fertiliser and fuel) and services (e.g. accountancy advice and marketing services) for use by farmers. These purchased inputs, plus land and associated resources, labour and management, are combined by farmers to produce farm products (e.g. wheat, wool and animals). Farm products pass through a number of processes before reaching final consumers in the desired form, time and place (e.g. wrapped and sliced bread, woollen slacks and T-bone steaks).

It is estimated that of each dollar spent by Australian households on food, from 60 to 70 cents pays for the off-farm activities of storage, transport, processing and distribution and the remainder goes to the farmer (Table 1). A similar figure of 62 per cent is quoted by Penn (1979) for the USA. The relative importance of these off-farm activities varies with commodities and over time for the same commodity.²

The most important cost item in providing the off-farm services is labour. Data compiled by the Prices Justification Tribunal (1979) put labour costs at between 40 and 70 per cent of the value added of food manufacturing, wholesaling and retailing industries. These labour costs are directly related to wage and salary rates in the wider Australian economy. The next most important set of costs are capital costs of interest, depreciation and repairs and maintenance of buildings and equipment. Some of the equipment is imported. Packaging materials and energy are other important costs. Again the per unit costs of these items reflect economy-wide movements for similar materials.

² A recent issue of the *Agricultural Gazette of N.S.W.* (Anon. 1980) puts the farmers' share of the consumer's dollar at 23 per cent for potatoes, 19 per cent for tinned peaches and 63 per cent for fresh eggs. For time series data on meat margins see various issues of the NSW. Department of Agriculture *Commodity Bulletin* (e.g. Griffiths and Hough 1981).

TABLE 1
Distribution of Australian Consumer's Dollar Spent on Food
 (average 1975-76 to 1977-78)

Item	Total	Proportion of food expenditure
	\$m	%
Private final consumption expenditure on food	7164	100
Estimated farm value of products for domestic use	2611	36
Margin for storage, transport, processing and distribution	4553	64

Sources: Final consumption expenditure from ABS (1980). Farm value of products for domestic use is estimated from data in the appendix where it is estimated that about 45 per cent of the value of farm produced products go to the domestic market. (Note that some imports—about 3.5 per cent of the final consumption figure—are not considered here.) The margin is derived as the difference between consumer expenditure and farm value.

The prices charged for off-farm production and services are influenced by market structures and conduct. Industry concentration statistics show that only for a few industries, including margarine and government controlled rail transport and grain storage monopolies, do the top four firms control more than 50 per cent of the national market.³ A number of extensive public inquiries have reported no evidence of above-normal profits of firms in the food processing, wholesaling and retailing industries.⁴ However, taking the short run, which may be several months, there is considerable evidence of price levelling and price averaging which tends to distort the short-run relationship between prices charged for services and the costs of supplying them for particular products.⁵ Taking a range of products as an aggregate, the pricing strategies of firms in these industries approximate those of a competitive model in the sense that they pass on cost increases and productivity gains in terms of retail prices and farm price offers, particularly over the longer term (three months or more). Alternatively, the marketing margin between farm and retail prices is largely determined by, and reflects the costs of, providing attributes sought by consumers.

The export market is a major outlet for Australian agricultural products. A little over one-half of the aggregate value of farm output is ex-

³ Data from ABS (1976). The national figures disguise local monopoly control, but such control is held within bounds by transport costs.

⁴ See, for example, reports on the meat industry by the Parliament of N.S.W. (1972), Cozens (1973), the Parliament of the Commonwealth of Australia (1973), and the Prices Justification Tribunal (1978, 1979).

⁵ A study of pricing in the NSW meat industry by Griffith (1974) found evidence of short-run price levelling, i.e. averaging out perceived temporary changes in basic input prices in the final product price, and price averaging, i.e. the practice of accepting a higher marketing margin on one product to offset lower margins on other products, but that the effects of price levelling and averaging do not extend beyond three months (see also Naughtin and Quilkey 1979). It is likely that similar practices occur with other food products. The Prices Justification Tribunal (1979, p. 111) noted that a '... basic approach to pricing included the need to generate sufficient revenue to cover costs and to allow enough profit to warrant an adequate level of investment ... the high degree of competition in this industry resulted in prices being held largely at levels which closely related to movements incurred in manufacturing costs'.

ported (see Appendix for details). The importance of the export market varies from 95 per cent for wool, 80 per cent for wheat, rice and sugar, 50 per cent for beef and sheep meat, and less than 50 per cent for manufactured dairy products. Commodities in the non-traded goods category include fresh milk, pig meat, poultry, eggs, potatoes and other vegetables. Agriculture still provides nearly one-half of Australia's total exports. Trade with the rest of the world is an important component of the total Australian economy with about 15 per cent of GDP being export sales. The Australian economy in general, and the agricultural sector in particular, is highly integrated with, and dependent upon, developments in the world economy. For this reason useful modelling and analysis of the agricultural sector must recognise international links.

Even with export sales, substantial off-farm costs are incurred between the farm gate and the export buyer. Many of these costs are domestic since the farm products require transport, storage and processing. Examples of the latter include the slaughter, cutting, trimming and so forth of animals into meat products, rice milling, and sugar crushing and refining. The costs of shipping products overseas are important. For example, Sampson and Yeats (1977) estimate that ocean transport costs increase the price of Australian primary products landed in the USA relative to the Australian (f.a.s.) seaboard cost by 26.5 per cent. An important component of the transport costs are Australian labour and other costs incurred in loading and servicing mostly foreign-owned ships.

There has been a trend towards greater dependence by farmers on the use of off-farm supplied materials, services and capital items with the development of greater specialisation, technology and the substitution of relatively cheaper capital and materials for labour (see Smith and Smith 1978). These inputs purchased from the non-agricultural sectors now account for between one-half and two-thirds of the gross value of farm production. The aggregate picture is shown in Table 2.⁶

Our knowledge of the structure and conduct of the farm input supplying industry is limited. On the basis of data on concentration of market power, some components, such as the fertiliser, feed manufacture, agricultural chemicals, petroleum and perhaps wool broking industries, are highly concentrated in the sense that the four largest firms provide more than 50 per cent of total industry sales. Others, such as many contractors, local stock agents and retailers of agricultural materials, are closer to the atomistic competition end of the market structure spectrum. While Bernasek and Kubinski (1963) described much of the agricultural machinery and implements industry as 'clearly oligopolistic', this seems inconsistent with recent ABS data on industry concentration.⁷ The limited available information on profits relative to capital employed—limited largely by aggregate data provided by conglomerate corporations—does not suggest that many of the farm input supplying industries have been able to sustain above-normal profits over the long run. Even if we accept some monopolistic features of these industries, they still will pass on some of the changes in costs of providing goods and ser-

⁶ While Table 2 is based on ABS data a similar picture can be gained from data collated by the BAE. The latter also provide more detail for particular industries and zones.

⁷ Data from the ABS (1976) indicate that the four largest enterprises account for only 35 per cent of market turnover. A more disaggregated picture by types of machines would indicate a higher level of concentration.

TABLE 2
*Value of Sales and Expenditure
 on Non-Farm Inputs by
 Australian Farmers
 (average 1975-76 to 1977-78)*

Item	Amount	Proportion of net sales
	\$m	%
Value of net sales	5163	100
Expenditure:		
Materials	1312	26
Services	1218	24
Capital items	799	16

Source: ABS (1979)

VICES to farmers.⁸ In short, the farm input supply industries can be expected to pass on cost increases incurred in their operations to their farmer clients, although there may be time lags and some averaging of cost increases across products and services.

To a large extent the costs of providing materials, services and capital to farmers are tied to economy-wide costs. Labour is a large cost item, particularly in the case of services, which include the distribution and servicing of material and capital items. Some of the materials (e.g. phosphatic fertilisers and chemicals) and some of the equipment have a large import component.⁹ Prices to farmers for these items will be influenced by world prices, exchange rate and domestic industry protection/assistance arrangements and domestic costs.

The return to farm land and owner-operator labour and management can be described as a residual or rent. This is true for land in both the long run and the short run since most agricultural land has a very low opportunity value outside agriculture. It is less true for labour and management, particularly over the longer run, since these resources have relatively good non-agricultural employment opportunities and the available evidence suggests that farm labour supply does respond, but slowly, to changes in relative returns.¹⁰

A simple model may help to draw together the different stages of the agricultural production system. Final demand by consumers and importers for our products is influenced by retail and export prices, prices of substitutes, income and tastes. The nature of the demand curve, including the price elasticity and shifts of the curve as a result of the effects

⁸ Comparing the polar cases of a profit maximising monopolist and a competitive industry, the former sets price such that the marginal cost equals marginal revenue with price greater than marginal cost. The latter sets price equal to marginal cost. A shift upward (downward) of the marginal cost curve results in a higher (lower) price under both structures. In the perfect competition case price will shift by the same amount as the marginal cost shift, whereas the monopolist price shift will be by a smaller amount.

⁹ Smith and Smith (1978) cautiously estimate that imported items make up about 20 per cent of the cost of items purchased by farmers.

¹⁰ Ryan and Duncan (1974), for example, estimate the own price supply elasticities for self-employed labour for the short run (one year) and the long run (three years) at 0.09 and 0.18, respectively.

of inflation on income and other product prices, will be influenced by whether the product is a non-traded, export or import substitute commodity. Retail and export prices will be linked to farm prices by the costs of providing storage, transport, processing and distribution services. Output at the farm level is determined by farm prices received, prices paid for inputs, technology and seasonal conditions. The prices charged for off-farm produced goods and services reflect production costs, with labour costs being the most important and, critically, production costs are closely tied to general price movements in the economy. A residual farm income is given by gross farm receipts less expenditure on purchased inputs.

Within the above representation of the agricultural sector, attention now shifts to models for assessing the effects of inflation on agricultural prices, costs and incomes.

Price Effects

Models which provide insights into the effects of a surge in inflation on prices received for, and paid by, members of the agricultural sector are evaluated in this section. Throughout the analysis there are assumed to be no real changes such as technological developments, new discoveries or aggregate real income gains. Hence, such factors as the secular downtrend in the ratio of agricultural prices received to prices paid can be ignored.

Walrasian model

An important and simple situation is the closed economy model of general equilibrium theorists. Consider the special case where inflation means that all prices, both outputs and inputs, increase by the same proportion, say, by 10 per cent. The Walrasian general equilibrium model would predict no real changes because there have been no changes in relative prices. The demand function for each product is assumed to be homogeneous of degree zero so that a 10 per cent increase in all commodity prices and income (which is based on factor prices that also have increased by 10 per cent) has no effect on the number of units demanded. Similarly, the supply function is assumed to be homogeneous of degree zero in output and input prices. In this world, all prices would increase by 10 per cent, incomes, including farm income, would increase by 10 per cent, and quantities of commodities produced and inputs purchased would remain unchanged.

For a number of reasons the Walrasian model simplifies the complexity of reality in important ways. First, inflation itself may have real effects. Conceptually, the income redistribution, real balance, and uncertainty and expectations generating effects of inflation may affect both the aggregate level of real expenditure and the composition of that expenditure. While there is mixed empirical evidence on these effects, there is a growing consensus that inflation reduces the rate of real economic growth.¹¹ Because of the low income elasticity of demand for food the effect of this qualification will be small. Second, several econometric

¹¹ For a discussion of these issues in the Australian context see the papers in Reserve Bank of Australia (1979) and Nevile (1980).

studies to verify the postulate of homogeneity of degree zero of the demand and supply functions with actual data have reached mixed results. It may be that the postulate holds as an approximation only.

Third, the Walrasian model assumes instantaneous adjustment of all prices. Because of leads and lags in the economic system, rarely does inflation mean that all prices move proportionately during the short run which may be as long as a few years. Empirical evidence indicates a significant positive relationship between the variability of relative prices and the inflation rate.¹² An important instance of non-proportionality of price changes may arise between traded goods and non-traded goods and services when the model is extended to include international trade. This issue is considered in more detail below.

Extending the Walrasian model to include different lags in price adjustments will mean that inflation will have some short-run income redistribution effects. In general, those producers whose prices received adjust faster, and whose prices paid adjust slower than the general inflation rate, will gain a temporary income boost. Conversely, those whose prices received increase slower than prices paid will lose. These temporary gains or losses will not be offset by subsequent price movements since the longer-run tendency is a monotonic drift towards constant relative prices. I am unaware of a set of theory, or of empirical evidence, which unambiguously demonstrates that the lags in individual price adjustments, and particularly the comparative lags, are significantly and consistently influenced by market structure and institutional characteristics.

Partial equilibrium commodity models

Individual commodity models can be used to isolate different patterns of price response for different commodities and to assess the time path of price changes. The emphasis here is on the distinction between prices received for traded and non-traded goods in a short-run context.

Consider non-traded goods such as fresh vegetables, poultry, fluid milk and eggs. Inflation will result in cost increases at all levels of these industries. For example, the important labour cost item rises with inflation either via explicit institutional arrangements, including indexation, or by other social and market forces. But, because inflation means higher nominal incomes and higher prices of other commodities, demand for the non-traded products will also increase. Market forces will tend to increase all prices and costs by about the same proportion and cause no change in real quantities. This picture is unlikely to be altered markedly where prices are determined by governments rather than by market forces. It is evident that cost of production formulae loom large in government intervention into agricultural prices. In fact, inflation might be used as a screen to hide real productivity changes that imply a desirable fall in relative prices.¹³ Overall, inflation is unlikely to have large or prolonged effects on relative prices paid and received or on real incomes of those in the non-traded agricultural industries.

Consider now the case of export industries where domestic inflation is

¹² See Clements and Nguyen (1980) for an analysis with Australian data and for references to studies in other countries.

¹³ This observation was suggested by Alistair Watson.

faster than overseas inflation. Further, for expositional ease, assume that the world demand for the country's exports can be considered perfectly elastic.¹⁴ Domestic inflation will result in an increase in the cost of domestic labour and goods used in providing inputs to farmers and an increase in the costs of storage, transport, processing and distributing farm products. To the extent that some of the items are imported so that their cost is, in part, tied to world prices, the average cost increase will be less than the domestic inflation rate. Because of the lower inflation rate overseas, the world price of the export good will not rise as fast as domestic costs. The combination of a relatively faster rise in the price of inputs used relative to export receipts will squeeze returns to the export industry. The fall in returns will be absorbed by a fall in rents on fixed factors, of which agricultural land is an important member.

The export model provides a framework for assessing the short-term effects of inflation on the prices and incomes received for Australian agricultural commodities dependent on exports for a large share of their sales, e.g. wool, wheat, coarse grains, red meats, sugar and dairy products. The simple model applies to all the output only when prices for both the export and domestic sales move in unison. This is the case for red meats and wool. For some of the other products, including wheat, sugar and dairy products, two-price schemes operate. Where the domestic price is closely tied to domestic costs of production, which has been the case for wheat, sugar and dairy products, the domestic portion of output is protected from the effects of inflation, although there are likely to be adjustment lags. Even with this protection, inflation will squeeze the nominal as well as the real returns to fixed resources, particularly land, held by producers of export products.

Two critical assumptions of the traded goods model are that of a constant exchange rate and continuation of the relatively faster rate of inflation in Australia than overseas. The next model challenges the validity of these assumptions.

Purchasing power parity

There is an extensive body of literature devoted to the concept of purchasing power parity (PPP) which argues that rates of inflation in different countries and currency exchange rates will adjust so that there are no long-term changes in relative prices across countries and between traded and non-traded goods within a country. Alternatively, it means that there is a tendency for the real exchange rate to remain constant. Algebraically, the relative version of the PPP can be expressed as:

$$(1) \quad e - (p - p^*) = 0,$$

where e is the change in the exchange rate (measured as Australian dollars required to purchase one unit of foreign currency);

¹⁴ The model developed by Tweeten and Quance (1971) illustrates how the analysis can be readily extended to allow for a less than perfectly elastic commodity demand curve. So long as the input demand curve is less elastic than the commodity demand curve, the qualitative results of the simplified analysis hold. Theoretically, it seems unlikely that a derived demand curve for all inputs could be more elastic than the product demand curve. Also, the export demand curve for our agricultural products as an aggregate is likely to be highly elastic.

p is the Australian inflation rate; and
 p^* is the foreign inflation rate.

The identity may be disturbed by any of the three variables and a return to the equality may come from adjustment of any one or a combination of the three variables.

While most economists subscribe to the PPP concept as a long-term tendency, there is a lively debate in the literature as to the underlying causal mechanism(s), the speed of adjustment, and appropriate empirical tests.¹⁵ For the purposes of this paper the main interest lies in the process of adjustment that follows from a period of relatively fast Australian inflation, i.e. $p > p^*$. The faster rate of inflation in Australia will work to reduce the relative price of Australian traded to non-traded goods and, also, to increase the relative cost of producing Australian traded goods relative to overseas traded goods for the reasons discussed above. These signals will lead to a rise in imports, a fall in exports and deterioration of the balance of trade. Discussion at a recent conference (Reserve Bank of Australia 1979) suggested that, over the long run, the elasticity of demand for imports with respect to relative Australian to world prices was a little over unity, and that about two years was required to effect one-half of the long-term response. Similar estimates are not available in the case of exports, but it is generally conceded that there would be long lags associated with investment in agricultural, mining and manufactured exports. The loss of competitiveness of the traded goods sector may exert some downward pressure on Australian prices and costs. The reverse picture is happening in the rest of the world. All these forces exert pressures for a devaluation of the Australian dollar, a slower rate of Australian inflation, a faster rate of overseas inflation, or some combination of these forces.

In addition to the effects on trade flows and prices, there may be effects on the portfolio preferences and decisions of Australian and foreign asset holders. In models with a large monetary component (e.g. Mundell 1971 and Dornbusch 1976), changes in relative rates of inflation and the exchange rate will induce, in the very short-term, substantial switches in the holdings of domestic and foreign money assets and securities which will force PPP to hold in the short as well as the long-term. Both the theory and empirical support for the monetary relationships are in a state of controversy.¹⁶ Nevertheless, monetary considerations reinforce the PPP doctrine.

In general, a surge of Australian inflation relative to that of its main trading partners will set in motion trade, price and capital switches that will force a return to the same real purchasing power of the Australian dollar and similar relative prices for traded and non-traded goods. However, a few years may be required to restore equilibrium. Evidence

¹⁵ A good review of the issues is contained in a symposium recorded in the *Journal of International Economics* (see for example Dornbusch and Jaffe (1978)). Some of the important concepts in the context of Australian agriculture are discussed by O'Mara, Carland and Campbell (1980).

¹⁶ An empirical study by Frankel (1979) on the relationship between the US dollar and the German mark showed that short-run capital flows can be explained by relative nominal interest rates at home and abroad, relative expected inflation rates and anticipated changes in the exchange rate. When a disturbance creates a diversion from PPP, about 20 per cent is removed by the end of one quarter and about 44 per cent by the end of one year.

submitted to the Campbell Committee of Inquiry into the Australian Financial System indicated that the present 'managed float' Australian exchange rate is adjusted in accord with long-run market forces, and that the PPP doctrine has an important influence on decision making.¹⁷

Acceptance of PPP means that in the long run, inflation of itself has no effect on the relative prices of traded and non-traded goods. For producers of Australian agricultural export commodities, it means that relative prices received and prices paid will return to the original ratio and that real income will not be affected.

Asset Effects

Modern agriculture involves a large investment in land, buildings, machinery and equipment, livestock and goods in process, and the sector is dependent, in part, on other sectors of the economy for finance. The effects of inflation on the prices and costs of holding various agricultural assets are considered in this section.

The farming sector as an aggregate has a substantial outlay of funds per establishment (which in the majority of cases is a family farm). ABS (1979) survey data for 1977-78 show the average value of assets per establishment in excess of \$200 000 made up of land, buildings and other structures (about 75 per cent of the total), motor vehicles, machinery and equipment (about 12 per cent) and livestock (about 13 per cent). Gross indebtedness of the farming sector amounts to about 10 per cent of the value of assets. The limited evidence indicates that the farming sector is a net borrower of funds from the rest of the economy. Hawke's (1980) estimate of the flow of funds in Australian agriculture in 1977-78 put interest paid at 3.8 times interest received. This figure provides a rough guide only to relative monetary assets and liabilities because interest rates received and paid differ. A more restrictive but accurate picture is given in the study of wheat farms in the Central Macquarie Statistical Sub-division of NSW by Davis, Mullen and Bryant (1979). They estimate cash liabilities at about \$20 000 and cash assets at about \$8 000 for the average farm. Clearly, the average asset picture described here varies markedly between individual farms.¹⁸

Off-farm components of the agricultural sector hold assets. These include buildings, machinery and equipment, and goods in process and stocks. In general these industries are net debtors to the rest of the economy.

How then does inflation affect the values of assets and, in particular, does it cause real capital gains or losses on particular agricultural assets? Consider land. Land prices are influenced by current and expected future returns to land, by expected capital gains, by credit terms, by taxation arrangements, by the discount rate and by what Clark (1973) terms 'amenity values'. Studies of changes in land prices in the USA (Lee and

¹⁷ See O'Mara, Carland and Campbell (1980) for some quotations from evidence submitted by officers of The Treasury and the Reserve Bank of Australia. The estimated policy reaction function for the exchange rate in the Reserve Bank Model RF76 described in Reserve Bank of Australia (1977) places considerable importance on PPP.

¹⁸ For example, BAE (1977) survey data indicate an extremely skewed distribution of farms by debt level. At 30 June 1975, it was estimated that 40 per cent of rural producers had no debts and another 23 per cent had debts of up to \$10 000.

Rash 1976; Melichar 1979), in Canada (Chase 1980) and in the UK, (Traill 1979) indicate that the rational economic model and the capital budget model of asset value determination have good explanatory powers with time series data. The limited Australian analysis (Powell 1974), which is bedevilled by inadequate data, suggests that these models are fairly consistent with the Australian experience. Given that broad movements in land prices can be explained by the capital budget model, the effects of inflation on land values are discussed in terms of the effects of inflation on returns to land and on interest rates.

The capital budget model postulates that land values will move approximately at the same percentage rate as changes in current and expected returns to land (for details see Melichar 1979). The previous analysis suggested that inflation may cause a temporary fall in returns to land, particularly for land used in producing traded rather than non-traded goods, and that there will be very small or no long-term effects. Clearly, the way expectations are formed is critical. If expectations are of the rational variety, then the effect of the temporary fall of income on land values will be small in the short run and negligible in the long run.

In the capital budget model, land values are negatively related to interest rates paid on borrowed funds and to the time discount rate. If these rates and the rate of nominal increase in land returns are the same as the general inflation rate, then land values will also increase at the general inflation rate. To the extent that nominal interest rates do not increase as fast as general prices during inflation, and this has been the experience in Australia during the 1970s, then land values will increase faster than general prices.¹⁹ On the other hand, it might be argued that the uncertainty associated with inflation results in the use of a higher discount rate. Further empirical work is required to estimate the effects.

It has been argued by some that land is, or at least is perceived by many to be, a good hedge against inflation and thus, that speculative buying will make this a self-fulfilling fact. While data for North America indicates that agricultural land prices have risen in real terms over the post-war period, the data collated for Australia by Powell (1974) and by Graham (1975) indicate very small real gains and even possible losses. Obviously more work on Australian land values, including data collection, is desirable if this issue is to be fully understood.

Turning to money assets, since both farm and non-farm firms in the agricultural sector are net borrowers, inflation generally confers net real capital gains to the sector. In part, this is because of fixed interest rates. Also, the real interest rate in Australia was negative during most of the 1970s. No doubt this phenomenon is partly explained by institutional rigidities in the Australian capital market, and particularly that concerned with providing funds to the farming sector. It should be noted, however, that there is no economic law which says that nominal interest

¹⁹ A succinct summary of nominal, real and post-taxation real interest rates for Australia is given in Bartholomew (1980). There are conflicting theoretical arguments about the effects of inflation on nominal and real interest rates. Discussion centres around anticipated and unanticipated inflation (in general interest rates follow the former but not the latter); the effects of corporate and personal income tax (see for example Feldstein 1967) with the answer depending on empirical facts; and on the interest sensitivity of the marginal efficiency of investment and liquidity preference schedules.

rates should rise at a slower rate than prices; in fact, the more reasonable theory is that they will fully reflect anticipated inflation.

Prices of livestock are directly linked with final livestock product prices. However, as in the case of land, the key variable is not today's price but expected prices over the next few years. Even so, while inflation will have little effect on the real or relative values of livestock over the longer run, it may depress them in the short term.

Real machinery and equipment prices are unlikely to be greatly affected by inflation since their prices are closely tied to general price movements. However, it seems likely that the combination of inflation and existing taxation arrangements will cause some income losses and, perhaps, changes in optimal replacement strategies.²⁰

Integration

In this section I draw together the different threads of my thoughts about the effects of inflation on Australian agriculture. It seems important to distinguish between the long-run picture and the short-run picture.

Taking the long run, which may be several years, it is doubtful that inflation will have large effects on relative prices of agricultural prices received and prices paid, on real asset values or on real incomes of members of the agricultural sector. For non-traded goods, such as fluid milk, poultry and fresh vegetables, general increases in the prices of other commodities and of community income will shift the demand curve by about the same proportion as inflationary costs shift the supply curve. In the case of commodities where an important proportion of sales are export sales, for example, wheat, wool, red meats and sugar, the argument is a little more complex. In the long run, market forces working on the balance of trade, capital transfers between countries and the exchange rate, and government exchange rate and general macroeconomic policy measures, will restore the effective exchange rate if Australian inflation should run ahead of (or behind) inflation in other countries. That is, assuming no real changes, a period of relatively rapid domestic inflation will have no long-run effect on relative prices of traded and non-traded goods. Given that inflation of itself has few long-term effects on relative prices and on real interest rates, then inflation will have few effects on the relative values or real purchasing power of physical assets including land, livestock and equipment. In general, inflation, and particularly unanticipated inflation, provides real asset gains to net borrowers of monetary assets. At the same time, inflation and current taxation arrangements result in real losses to holders of equipment, buildings and stocks in process. The net effects are unlikely to be very large for most members of the agricultural sector.

The short-run picture is more equivocal. There is ample evidence that inflation does not mean that all prices move proportionately in the short run. In the case of traded goods, and where domestic inflation is faster than inflation in the rest of the trading world, the surge of domestic infla-

²⁰ These issues are complex and there is much debate about the appropriate theoretical framework and of empirical applications. Swan (1978) presents a good review of the taxation arrangements and their effects in the Australian context. The replacement effects are discussed by Bates, Rayner and Custance (1979) and Bartholomew (1980).

tion will cause a temporary fall in the relative prices of traded to non-traded goods. For producers of agricultural exports, this means that prices received increase at a slower rate than prices paid and, hence, that there is a squeeze on both nominal and real returns in the short run. At this stage I am unaware that a definitive analysis of the period of adjustment before the real effective exchange rate is restored has been reported. With traded and non-traded goods, adjustment lags will mean that for some commodities costs rise faster than prices received and vice-versa. Further work is required to determine the structural, institutional, behavioural and other factors which influence price adjustment lags and whether agriculture or parts of the agricultural sector gain. The gains or losses are made for a short period only since, ultimately, all prices converge to the original pattern of relative prices. Also, they represent real gains or losses which are not offset by future compensating price movements. Such gains and losses may influence asset values. However, with rational expectations, much of the income effect will be treated as a temporary aberration.

The analysis raises several issues pertinent to a policy stance favourable to the Australian agricultural sector. The deleterious effects of inflation on returns, particularly in the export industries, are short run in nature. Somewhat related, a policy objective of lower inflation relative to that of our trading partners can only bring short-term and not long-term gains for export industries. This suggests a policy objective for inflation not at a zero level but at about the same level as that of our trading partners. A second set of issues concerns facilitation of the adjustment process so that the economy more quickly returns to a long-run equilibrium state. This includes flexible exchange rates, a competitive structure of both commodity and input markets, and cost escalation clauses in government determined price schedules.

Finally, agriculture in Australia is significantly interrelated with the rest of their respective economies and with the rest of the world. In preparing this paper I became aware of how little is known about the structure and behaviour of the non-farm agricultural sector in terms of answering such questions as their pricing strategies, their reactions to cost changes, to technological change, to instability of farm prices and quantities, and the forward and backward linkage effects of change at one stage of the sector on other production stages and the consumer.

APPENDIX

Exports of Australian Agricultural Products

The Appendix Table provides a broad guide to the distribution of production between the export and domestic markets. Data on production and exports come from BAE (1980) and personal communication with officers of the BAE. The percentages exported are derived directly from the figures for physical production and exports. In deriving the financial figure for exports, consideration was given to price differences between export and domestic sales in the cases of wheat, apples, pears, sugar, eggs and butter using data from the BAE (BAE 1980 and the *Situation and Outlook* documents for various products). For the other products, including coarse grains, rice, dried vine fruits, cotton, wool, beef and veal, sheep meat, cheese and other dairy, prices received for domestic

APPENDIX TABLE

Production and Export of Selected Australian Agricultural Products
(average 1975-76 to 1977-78)

Commodity	Physical quantities			Financial quantities		
	Pro- duction	Exports	Exports	Pro- duction	Exports	Exports
	kt	kt	%	\$m	\$m	%
Wheat	11051	9061	82	1078	875	81
Coarse grains	4937	2786	56	436	244	56
Rice (paddy)	479	381	80	54	43	80
Apples	278	48	17	83	12	14
Pears	122	61	50	22	9	40
Peaches	69	33	48	17	8	48
Apricots	26	2	8	10	1	8
Citrus	433	20	5	69	3	5
Bananas	105	*	*	43	*	*
Dried vine fruit	66	44	67	53	35	67
Sugar	3157	2345	74	443	369	83
Peanuts	35	*	*	17	*	*
Oilseeds	211	*	*	47	*	*
Tobacco	15	*	*	54	*	*
Cotton	32	10	31	46	14	31
Potatoes	732	*	*	91	*	*
Other vegetables	881	*	*	205	*	*
Wool	711	726	102	1126	1126	100
Beef and veal (carcass weight)	2004	952	48	965	457	48
Sheep meats (carcass weight) ^a	627	324	52	287	149	52
Pig meat	185	*	*	198	*	*
Poultry	223	*	*	184	*	*
Eggs (m doz)	187	31	17	120	11	9
Fluid milk (for domestic use) – ML	1567	*	*	268	*	*
Butter	126	48	38	133	44	33
Cheese	111	43	39	58	23	39
Other dairy	300	163	54	41	22	54
Other livestock	n.a.	n.a.	n.a.	77	n.a.	n.a.
Total	n.a.	n.a.	n.a.	6225	3445	56

* negligible exports.

n.a. not available.

^a Includes estimated carcass equivalent of live-sheep exports.

Source: See text.

and export prices were assumed to be identical. Almost certainly this assumption is a crude one.

The table does not take into consideration changes in stocks. This explains the excessively high level of export sales for wool. Stock changes may also affect the figures for the grains and sugar. For these and other reasons no great precision should be attached to the figures.

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