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Notes

- (a) The following contributed papers were not available for publication:
- Application of Technology to the Exploitation of New Zealand's Marine and Agricultural Resources
 G. Cleland
 - Restructuring, Risk, Uncertainty and Price Smoothing
 R.W.M. Johnson
- (b) No papers were produced for the following theme addresses:
- | | |
|---|--------------|
| Future Fiscal Directions | H. Fancy |
| Government Role in Research and Development | G. Scobie |
| Government Role in Research and Development | O. Coup |
| State Owned Enterprises | C. Williams |
| Rural Finance, Issues and Institutions | J. Pryde |
| Rural Finance, Issues and Institutions | K. Macdonald |

STABILISATION AND ADJUSTMENT : WHAT HAVE WE LEARNED?

R.L. Kerr, Executive Director, NZ Business Roundtable

Introduction

For the past three years, an economic strategy has been implemented in New Zealand which may be broadly characterised as a stabilisation and adjustment programme (in IMF and World Bank parlance) or as a programme for macroeconomic stability and microeconomic flexibility, to use the language of the OECD. This is an appropriate point to review experience to date, consider some criticisms of the policy framework and discuss some outstanding weaknesses. The treatment is necessarily selective.

Economic Performance

For a generation or more following the 1930s' depression - the decades of the New Zealand economic experiment - New Zealand adopted an economic policy framework which was significantly at variance with internationally recommended practice. As the relatively poor growth performance of the economy became apparent in the 1960s and serious imbalances developed in the 1970s, sporadic attempts were made to address the problem by more orthodox means. For example, in 1976/77 the fiscal deficit was reduced substantially, some interest rate controls were removed and a firmer monetary policy was adopted. From late 1978 to mid-1980 there was a period of fiscal and monetary tightening and a start to trade liberalisation. Each of these episodes, however, was followed by a reversal of major elements of policy

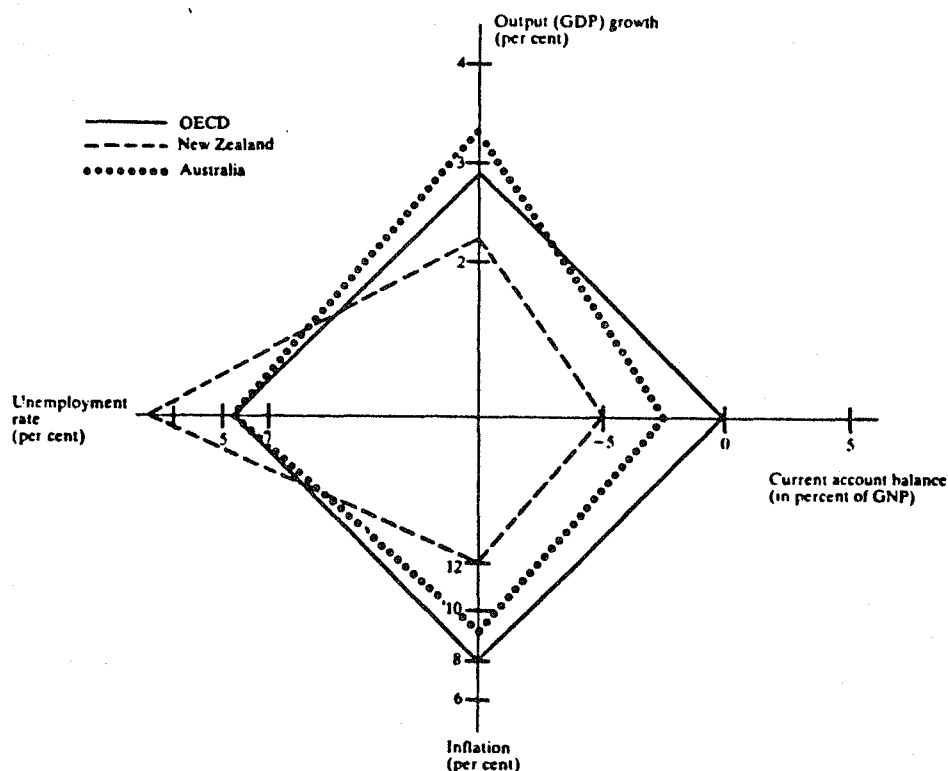
and an erosion of the gains made. More lasting progress was made in a few areas such as the deregulation of the transport sector and the establishment of a free trade area with Australia. The reform programme initiated in 1984 has, to date, proceeded on a more comprehensive scale and a more sustained basis.

By 1984 there was widespread community dissatisfaction with New Zealand's economic performance as indicated, for example, in the discussions of the Economic Summit of that year. Inevitably this assessment was not shared by all economists. Gould [1985] was sceptical of the view that New Zealand's performance was unimpressive and that previous policies had been inappropriate. There are acknowledged data problems in assessing long run growth performance, especially in respect of the real GDP statistics for the financial, insurance and real estate sectors, and other services. A study by Bascand [1983], however, cast doubt on whether the deterioration in New Zealand's growth rate and other economic indicators relative to those of other countries since the first oil shock could be attributed to terms of trade losses. The OECD [1987] stated that:

"New Zealand's relative economic performance over the past 15 years has been poor, both relative to the OECD average as well as compared with Australia which has an economic structure not too dissimilar from that of New Zealand".

This is illustrated in the following diagram:

Diagram 1. Relative economic performance
1970-85 averages



Note: The diagram plots major macro-economic performance indicators along the four rays from the origin. Measuring scales are chosen such that performance improves with distance from the origin. The diagram shows that New Zealand had less growth, higher inflation and a larger current balance deficit than Australia and the OECD on average, but that the country's unemployment rate has been lower.
Source: OECD, *Economic Outlook*, 40, December 1986 and OECD, *Economic Outlook: Historical Statistics 1960-1984*.

Source : OECD Economic Surveys 1986/87 : New Zealand, p9.

The relatively better average unemployment outcome must be qualified by the observation that increases in employment have been modest during this period, productivity growth has been the lowest in the OECD region, and unemployment has been on a rising trend in the past decade. Moreover, such a snapshot does not fully capture the influence of such developments as increases in the tax burden or the stock of public debt which may impair economic performance over time.

It might also be noted that the comparison with Australia is not a flattering one, as Australia's performance has been at best mediocre. Also New Zealand's performance has been weak in areas where Australia's has been weak, but more so. This may suggest that common factors have been at work. One explanation, suggested by the work of Olsen, might be the effects of interest group coalitions, manifesting themselves in areas like trade protection and the labour market, over a long period of political stability and isolation from disturbances in the outside world.

Much more important than measures of comparative economic performance is a consideration of whether economic management in New Zealand realised the full potential of the economy. Many of the recent initiatives have been based on an extensive body of analysis which suggested that a number of interventions reduced the efficiency of the economy and, in addition, made a poor contribution to objectives of social equity.

Chronologies of the measures adopted since July 1984 are set out in recent Budgets and OECD reviews of New Zealand, and the principles underlying them are well known. In many ways the problems addressed correspond closely to those of other countries for which stabilisation and adjustment programmes have been recommended, including the development of unsustainable internal and external disequilibria. In evaluating the decisions made, account needs to be taken of the financial crisis of 1984 and the constraints it imposed on policy choices. Regard also needs to

be had to the political economy factors faced by policy-makers as well as technical aspects of policy design.

Review of Economic Debate

It is instructive to review some of the main criticisms of official policy advice and decisions in the light of experience to date. In doing so, it needs to be remembered that the stated policy framework is a medium term one, normally thought of as around 3-5 years, and that the effects of many of the decisions made have not yet worked through. The Minister of Finance has also recently stated (correctly) that the Government is only 50 percent of the way through what might be regarded as an orthodox programme of economic reform.

(1) Fiscal policy

One theme of criticism concerned the speed of attempts to reduce the fiscal deficit. Philpott and Easton, for example, argued that too much emphasis was placed on this objective (Philpott [1985], Easton [1985]). The concern that fiscal contraction would produce a 'hard landing' in the economy was essentially based on a Keynesian analysis. The Treasury in its Economic Management [1984] briefing expressed doubts about the weight to be placed on such an analysis. While speed was seen as a legitimate concern and a deficit reduction target of 2 percentage points per annum was suggested, it pointed out that policies to reduce the deficit were not necessarily more contractionary than

the consequences for interest rates and expectations of ongoing large scale borrowing and an increase in public debt. Moreover, efficiency-enhancing initiatives affecting public sector performance and supply conditions in the private sector were seen as offsetting such effects to some extent.

In a medium term context, it can be more strongly argued that growth will be greater the lower the accumulated tax burden from debt overhangs associated with previous borrowing to support consumption and/or low return investment programmes. In addition to the adaptive and rational expectations critiques, the Keynesian focus on flow issues (income generation) and neglect of stock issues (debt) seems a major deficiency in the economic framework many economists brought to fiscal policy discussions in the last 30 years. Where debt was included it was typically in terms of debt instability, which merely contained the idea that an explosive state could occur if interest rates exceeded growth rates. Even now, it is difficult to find material in the economic literature which offers policy-makers many insights into the question of optimal medium term deficit targets or objectives for public sector net worth.

Even though the deficit has been brought down from a measured 6.9 percent of GDP (GFS basis) in 1983/84 to an estimated 2.2 percent in 1987/88, from a technical point of view it seems clear with the benefit of hindsight that progress has been too slow rather than too rapid. At no stage has a sharp recession appeared likely, and economic forecasters have consistently underestimated

real GDP growth. Investor confidence was sustained when clear evidence was available of progress in achieving fiscal control, and faltered at times of uncertainty. However, this judgement on speed needs to be balanced by an appreciation of the time required to develop sound medium term initiatives, and the need to maintain a constituency for the overall programme.

It is likely that further fiscal consolidation may now, on balance, still be contractionary in the short term (although the possibility of dollar-for-dollar crowding-in cannot be ruled out). However, there now appears to be a broad consensus that high priority should be attached to maintaining the progress made on deficit reductions and reviewing government outlays which are not cost-effective or well-targeted. From a macro perspective, greater emphasis on fiscal action is likely to put more of the burden of adjustment on the non-tradeables sector and less on tradeables. To reduce the massive overhang of public and external debt, a series of fiscal surpluses in the medium term would appear to be a desirable policy goal, as has been recognised in recent Government statements.

Experience appears to have confirmed the shift in economic thinking away from Keynesian approaches to deficit spending. Buchanan [1987] has called attention to the intergenerational inequity involved in forcing our children to pay for current spending policies, and has argued that 'the basic moral dimension of fiscal policy must be elevated to centre stage'. Attention is now being focused more directly on government

spending, and hence on efforts to improve the extent to which efficiency and equity objectives are achieved through the government's fiscal interventions.

(ii) Exchange rate management

A second criticism of official policy concerned the exchange rate regime. Indeed, despite sweeping criticisms of the economic framework adopted by the Treasury and the Reserve Bank in their post-election briefing, this was the only area in which Zanetti and others [1985] committed themselves to an alternative policy prescription. They incorrectly suggested that arguments for a floating regime were derived from a simplistic monetary approach to the balance of payments. Instead the case relied much more heavily on a comparative institutions framework : did bureaucrats and politicians possess better information and have superior incentives to make sound decisions about the price of foreign exchange than market participants? Furthermore, were there sound reasons for suppressing, via controls, the role of the nominal exchange rate in facilitating the external and domestic adjustment task? These questions were particularly important in a period of major changes to commodity exchange rates (effective rates of assistance) in the traded goods sector, and in the labour market with the removal of wage controls.

From a similar perspective ('that there is no reason to suppose that central banks have any special gift for outguessing or even correctly guessing where the market is or should be going'),

Clower [1984] commented at the time that 'the efficiency-creating potential of a move by New Zealand from fixed to freely floating exchange rates is too obvious to require argument'. While few would go so far as to advocate a floating regime for all countries in all periods, experience since the float in March 1985 appears to support this conclusion in current New Zealand circumstances. It is difficult to believe that an alternative regime would have coped nearly as well with the domestic financial sector adjustments, the swings in international currencies and the large changes in effective rates of assistance in the goods market that have characterised this period. In the circumstances, the relative stability of the New Zealand dollar (on a monthly basis) has been a surprising feature. Moreover, although this was not a primary motivation, floating has helped reduce monetary policy uncertainty and contrasts with the difficulties Australia seems to have experienced since it commenced interventions to prop up the Australian dollar.

There now seems to be a broad political consensus in New Zealand in favour of a free float, although some special interest groups may continue to put forward arguments for 'managing' the exchange rate towards a more 'appropriate' level (and, as always, an economist may be found who will support their case). There have also been some interesting recent insights offered in the economic literature on floating. In an article in which he concluded that alternative regimes, including taxes on capital flows, are not clearly preferable to freely floating exchange

rates, Dornbusch draws an interesting comparison with bond and stock markets:

"Many economists would be coy in responding to proposals to set target zones for interest rates or for the stock market. They would ask immediately how these target zones are to be made to 'stick', and would certainly be concerned if the answer was monetary policy... But what is different about target zones for exchange rates? The only difference I can see is that target zones for interest rates or the stock market are discredited (perhaps excessively), while exchange rate fixing is a fad that has a way of coming back" (Dornbusch [1987], p 49).

Although floating has produced few surprises, there are some features which have emerged more clearly with experience. One is the ability of financial institutions and firms to climb the learning curve associated with foreign exchange management. This contradicts some fears held at the time and tends to confirm other evidence (e.g. Black [1976] and Lal [1980]) that the institutional requirements of a floating exchange rate system are possibly exaggerated. It has also become clearer that the foreign exchange market performs an additional extremely important role, especially in a political system with as few checks and balances as New Zealand's, in monitoring the quality of economic management. The slide in the Australian exchange rate since February 1985 highlighted the weaknesses in that country in budgetary and labour market policies, in particular, in a dramatic way. While there are separate and compelling arguments for electoral reform in New Zealand to lock in the

incentives for maintaining sound economic policies, open foreign exchange' and financial markets will continue to signal shortcomings in a speedy and unremitting manner.

More speculatively, the floating rate system has perhaps helped to demonstrate the consensus-building properties of the price mechanism. Politically it would have been very difficult for a government to find any analytical basis for deciding how to 'manage' the exchange rate - whether upwards to reduce inflation or downwards to help exporters - over the last three years. A major problem is that economists have a poor grasp of the question of optimal capital flows through the balance of payments on which to base a view about an appropriate short term profile for the exchange rate. Nor, for that matter, do governments really have the resources to control it.

(iii) Sequencing

Associated with the debate on exchange rate management have been criticisms of the order and timing of policy changes. Zanetti and others claimed this issue had been completely overlooked by the Government's advisers and Federated Farmers [1987] have recently referred to an 'incorrect sequencing of economic reform'.

Contrary to the Zanetti claims, New Zealand policy advisers made the relationship between macroeconomic policy and economic

liberalisation a major topic of research and inquiry amongst international specialists during 1983 and 1984. This work motivated the suggestion in the exchange rate chapter in Economic Management that the 'essential agenda for discussion' was:

"...the sequence of macropolicy and market liberalisation moves, and the communication of their implications to the public and to labour market participants in particular, which would facilitate the smooth introduction of a floating regime" (p 169).

The order adopted by the Government was essentially the removal of capital market controls (in conjunction with the 1984 devaluation), a programme to reduce the fiscal deficit initiated in the 1984 Budget, the removal of exchange controls followed by the float, an acceleration of trade liberalisation, and the removal of wage controls followed by limited steps to free up the labour market. This sequencing was driven by the harsh realities of events, the differing times required to implement various policy measures and the need to promote confidence in the entire strategy, as well as theoretical considerations.

Based on the experience of the Southern Cone countries, some writers (e.g. Krueger [1984]) have put forward the view that in liberalising the foreign exchange, domestic credit and labour markets, the capital account of the foreign exchange market should be liberalised last. Exactly how the exchange rate might be defended during this period is somewhat unclear. This 'technocratic' view has been disputed in a recent article by Lal [1986] based on a political economy analysis of economic

liberalisation. He argues instead that a package which will most effectively reduce the costs of adjustment is initial liberalisation of domestic capital markets simultaneous with cuts in the fiscal deficit, followed by floating the exchange rate and then commodity market liberalisation.

Lal's analysis is too lengthy to summarise in full, but the remarks on the liberalisation of the capital account are of special interest in the New Zealand context. He notes that the real worry of the opponents of liberalisation of the capital account is that it could lead to an overshooting of capital inflows with an accompanying overshooting in the real exchange rate. But he points out that if there is a sustainable level of foreign capital inflows following liberalisation, then the resulting exchange rate appreciation cannot be regarded as a problem for the country. Even if the real exchange rate were to first appreciate and then depreciate over time, involving an initial expansion and then contraction of the non-traded goods sector, this cannot be said to constitute an inefficient adjustment process unless one assumes that the government knows the correct time path of the real exchange rate while myopic and/or ignorant private agents do not. Moreover, if the overshooting argument against the removal of capital controls is correct, it should apply at any time, irrespective of whether or not trade liberalisation has taken place.

In its application to the New Zealand setting, this analysis complements the findings of studies that cast doubt on simplistic

linkages between high fiscal deficits and high interest rates (e.g. Evans [1985]) and on the further linkage between interest rates and the exchange rate (e.g. Wilkinson and Keenan [1986]). The latter point out that from an international bond market perspective, causation does not run from interest rates to the exchange rate. Rather, both are endogenous, and a drop or rise in interest rates may be associated with a rise or fall in the spot exchange rate depending on what is causing world perceptions of New Zealand to change. Wilkinson and Keenan argue that it is New Zealand's past economic performance, in terms of inflation and a soft currency, which is likely to explain recent domestic interest rate levels and that a lower risk premium can only be achieved by consistent pursuit of sensible monetary and fiscal policies. The particular exchange rate and interest rate configuration we observe therefore reflects, amongst other things, a combination of confidence in the future of the New Zealand economy (affecting desired capital flows) and the legacy of the past built into interest rates.

Lal's conclusion is that most of the 'crises' that require the stabilisation cum adjustment medicine are primarily crises of the public sector and other interventions motivated by special interest groups. At the heart of the remedial programme of gaining fiscal control by reducing public expenditure and removing inefficient economic regulations is the need to confront or buy out vested interests. Seen from this perspective, he argues that the order of liberalisation which minimises the adjustment costs is less important than its political

sustainability, and that "for the credibility of the process, speed in implementing the liberalisation of the various repressed markets may be of the essence". At the technical level, he recommends a floating exchange rate system, the absence of which largely explains, in his view, the Southern Cone debacles.

On these criteria, the policy choices of the New Zealand authorities would appear to score relatively highly. It would have been naive to expect faster initial action on labour market reform given the political interests involved, the inertia involved in that market and the need to develop community understanding of the need for change, although the slowness of subsequent progress has been disappointing. By contrast, the early removal of capital market distortions has facilitated a more efficient allocation of capital to new investment opportunities. However, Lal's argument draws attention to the need to maintain evenhandedness and a rapid momentum of reform, and to concentrate on outstanding policy weaknesses in the public sector, the labour market and trade liberalisation.¹

(iv) Microeconomic policy

The thrust of New Zealand's microeconomic policy reforms has

¹ A comment by an overseas visitor on a draft version of this paper seems an appropriate summary on sequencing :

"What a strange (and very academic) issue for the debate to get hung up on! So long as changes are made quickly enough and future directions are clearly foreshadowed, any adjustment costs from less than ideal sequencing will hardly be large."

found more favour among academic economists, although exceptions can be noted (e.g. Sheppard [1987]). Thus Philpott [1987] has awarded 'high marks' to initiatives such as the SOE programme, the dismantling of import control and subsidies, tariff reductions, the tax switch to GST and the introduction of competition. Philpott's current position is remarkable in view of his longstanding advocacy of planning and control approaches to economic management. For example, he has previously argued that import controls 'can be a most powerful and useful method of encouraging local import substitution industries and of saving foreign exchange', and indeed if industries were policed by price control 'total prohibition of imports would be justified' (Philpott [1972], p 273). His support for current microeconomic policy does not extend, however, to the key markets for labour and foreign exchange. Although there is now tripartite agreement in favour of free wage bargaining, Philpott has continued to support wages and incomes policies, as well as an administered exchange rate. This distinction between microeconomic flexibility and macroeconomic controls lacks analytical coherence, as the comment by Dornbusch quoted earlier implicitly indicates.

In the area of market liberalisation, experience since 1984 confirms earlier indications that the economy can absorb a relatively rapid rate of reduction in protection and subsidies without incurring a significant under-utilisation of resources. Hopefully we have heard the last of predictions that protection

reductions would throw 400,000 people out of work. A major international study of trade liberalisation in 19 countries recently conducted under World Bank auspices concludes that "the costs of adjustment as reflected by unemployment do not seem to be significant in most cases" (Papageorgiou, Michaely and Choksi [1986]p 14). It seems clear that employment trends are much more strongly determined by the development of unit labour costs and labour market flexibility, and that the way to reduce the adjustment costs of trade liberalisation is to reduce barriers to labour market adjustment. On the other hand, the income distribution consequences of liberalisation can be significant, as experience in the farming sector has shown. Many writers have observed that this factor explains the frequent opposition to change among management level employees in protected industries.

It is perhaps regrettable that outside the government agencies there has been little research and debate in New Zealand on such microeconomic topics as public enterprise policy, producer boards, competition policy and the labour market. This may be impeding advances in these areas of the type that have been seen in recent years in many overseas jurisdictions.

Conclusions

This brief survey of recent experience with stabilisation and adjustment policies is far from comprehensive, excluding, for example, any treatment of monetary and liquidity management. But it may point to the emergence of a more settled professional

consensus on some issues, which mirrors the convergence of approach which we appear to be witnessing in the broader political debate on economic management. One of the most important lessons of the past three years is without doubt the overriding importance of consistency and credibility about future directions. If this is established, rapid and efficient adjustment can occur with much lower short-run costs.

These developments may be a source of some satisfaction and of hope for the maintenance of sounder economic policies, but there is also a risk of a loss of perspective. New Zealand's economic problems, in forms such as the burden of public and overseas debt, the level and distribution of structural unemployment and the lack of productivity growth, remain massive. While the maintenance of present policies could see inflation under control within a couple of years, major ongoing initiatives are required to overcome other key problems.

Recent policy changes may have gone some distance towards stopping the rot but, by comparison with the stance of the most successful OECD economies, the present configuration of policy in New Zealand seems unlikely to lift its economic performance to anywhere near its full potential. No dynamic economy operates with tariffs at levels remotely approaching those of New Zealand and it is possible that with the slowness of reforms in industries like motor vehicles and apparel, and moves to eliminate assistance to many export and primary sector activities and goods not made in New Zealand, disparities in assistance are

currently worsening. New Zealand is almost unique in maintaining extensive state involvement in industries such as finance and forestry, and has been slow to reap the benefits of privatisation programmes of the type widely adopted in the OECD area. Furthermore, it risks committing errors made elsewhere of following commercialisation or privatisation policies for industries which continue to operate in highly regulated environments; the deregulation of markets such as telecommunications, broadcasting and petroleum products should occur at an early stage.

New Zealand's labour market institutions remain far removed from those of high employment, high productivity economies and are impeding the attainment of social goals. A great deal of evidence points to the crucial role of work and work experience - ranking well ahead of variables such as ethnic background, sex, class and education - in determining low income status. There has been little consideration to date of the performance of the health and education sectors which use resources equivalent to over 10 percent of GDP, nor to the effectiveness and cost of many aspects of the social security system. Spending in these areas accounts for a substantial proportion of the overall tax burden and high marginal tax rates negatively influence the supply of output by the economy. It is important that these social policy interventions are reviewed with the aim of ensuring that they represent the most cost-effective method of meeting the Government's social objectives, and that the least cost methods of financing social programmes are adopted.

It is possible, however, that the technical solutions to many of these problems will not be difficult to discover. Richard Prebble has recently made the interesting observation that New Zealand politicians from both sides of the House have known for years what was wrong with the economy and what needed to be done but considered it would be politically fatal to implement the appropriate policies (Douglas and Callan [1987] p 7). This may suggest that economic inquiry in New Zealand has concentrated too much on matters of economic allocation and stability and not enough on the lessons from the development of public choice theory over the past 25 years. There is little doubt that it should occupy a larger place in undergraduate programmes alongside the traditional preoccupations of welfare economics. Obvious and direct applications of the theory's insights apply to policy issues as varied and important as the autonomy of the Reserve Bank, the machinery of government, electoral reform and the scope for constitutional limitations on fiscal operations and regulatory interventions. The public choice literature also reminds us of the importance of the incentives facing politicians and the pervasive scope for government failure. A critical foundation for policies that promote the interests of the whole community is greater efforts at public education on economic affairs.

REFERENCES

- Bascand, G.M. (1983) "Some Cross-Country Comparisons of Economic Performance," New Zealand Association of Economists Conference, February.
- Black, S. (1976) Exchange Rate Policies for Less Developed Countries in a World of Floating Rates, Princeton University, Essays in International Finance 119, Princeton, N.J.
- Clower, Robert W. (1984) "Financial Reform in New Zealand : A New Beginning," Pacific Basin Financial Reform Conference, San Francisco.
- Dornbusch, Rudiger W. (1987) "Flexible Exchange Rates and Excess Capital Mobility," Economic Impact No 57.
- Douglas, R.O. and Callan, L. (1987) Toward Prosperity, David Bateman, Auckland.
- Easton, Brian (1985) Interview in New Zealand Times, August 11.
- Evans, Paul (1985) "Do Large Deficits Produce High Interest Rates," The American Economic Review, Vol 75, No 1.
- Gould, John (1985) The Muldoon Years, Hodder & Stoughton, Auckland.
- Krueger, A.O. (1984) "Problems of Liberalisation," in A.C. Harberger, ed., World Economic Growth, San Francisco, Institute for Contemporary Studies.
- Lal, D. (1980) A Liberal International Economic Order : The International Monetary System and Economic Development, Princeton, N.J.
- (1987) "The Political Economy of Economic Liberalisation," The World Bank Economic Review, Vol 1, No 2.
- New Zealand Federated Farmers, (1987) "Agriculture - Strategy for the Future."
- OECD, (1987) OECD, Economic Survey of New Zealand, Paris.

- Papageorgiou, D.,
 Michaely, M.,
 Choksi, A.M.(1986) "The Phasing of a Trade Liberalisation Policy, Preliminary Evidence," prepared for the Annual Meeting of the American Economic Association, New Orleans, December 28-30.
- Philpott, Bryan (1972) The Economic Mechanism, Reed Education.
- (1985) Article in The Press, October 16.
- (1987) "Restructuring and Manufacturing," Notes for Speech to Manufacturing Associations.
- Sheppard, David (1987) Article in Evening Post, 13 June.
- The Treasury (1984) Economic Management.
- Wilkinson, Bryce and
 Keenan, Peter (1986) "Interest Rates, Exchange Rates, and Government Policy," Jarden and Company.
- Zanetti, G.N. and
 others (1985) "Opening the Books," New Zealand Economic Papers, Volume 18.

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THE ROLE OF GOVERNMENT IN MULTILATERAL TRADE NEGOTIATIONS

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The views expressed in this address are the author's and should not be attributed to the organization for which he works.

The theme of my address today can be expressed quite simply - although I hope it is not simplistic. It is that another round of international trade negotiations cannot restore order in international trade as long as it deals only with the international symptoms of the crisis, and not its national causes. Without some basic changes in national policy-making environments in the major GATT countries, there is a very real danger that the Uruguay Round will founder. My object is to identify the sort of changes that are needed and to outline a recent proposal for achieving them.

That the Uruguay Round is happening at all, given the negative attitudes of some of the key players, is quite remarkable. What it shows is that most governments are genuinely alarmed at the protectionist trends, both in their external markets and at home. It also suggests that governments believe that, on their own, they are impotent to deal with them.

It is conventional wisdom among commercial diplomats that a multilateral negotiation in process deters protectionism. This has come to be known as the 'bicycle theory of trade negotiations', meaning that if we don't keep peddling we'll fall off. But the experience of the Tokyo Round belies that assumption. It was at that time, when concessions were being swapped in Geneva and new codes of conduct formulated, that some of the most protectionist actions of recent times were taking place: the global protection regime for textiles and clothing was greatly strengthened, the steel trigger price mechanism was introduced in the US, and the protected cartels for steel and synthetic fibres were being perfected in the European Community.

To now conduct a new round of trade negotiations on the same old premise - that protectionism can be stopped just through negotiations in Geneva - puts me in mind of one of Dr Johnson's famous quips. (I refer to Samuel not Harry). As I recall it, when told of the decision of a recently divorced acquaintance to remarry, he remarked: 'That sir, represents the triumph of hope over experience'.

In the case of Dr Johnson's friend, his hopes may well have been justified. But the outlook for the Uruguay Round, despite its bulging agenda, is less than promising. In the short time since negotiations were launched in Punta del Este, we have witnessed the escalation of the subsidy war in agricultural trade, widespread support for new protectionist bills in the US Congress, and discriminatory actions against Japanese trade which are unprecedented in GATT's history - and that is saying something.

These actions certainly seem to deflate the bicycle theory. Not only do GATT negotiations appear to have little effect on day-to-day protection decisions, the GATT rules themselves appear to have become largely irrelevant to actual policy conduct.

It is not that governments openly repudiate those rules. On the contrary, they can be found reaffirming the fundamental norms of GATT at international meetings all over the world.

Indeed it would be difficult for them to do otherwise, for the basic rules of GATT - non-discrimination and tariff-only protection - are unexceptionable enough. Their value was demonstrated to all by the economic and political consequences of their absence in the 1930s and 40s. The unhappy trade policy experience of that time also convinced governments that international commitments which constrained each country's freedom to 'beggar its neighbours', could also prevent governments from beggaring their own populations. They also believed that an explicit international-legal agreement would strengthen them in their dealings with domestic pressure groups, disciplining their trade policy in the national interest.

If the principle was sound, its execution was not. The General Agreement, in its final form, contained exceptions to almost every rule. It is a compromise document, in which the influence of the producer interests - which it was designed to constrain - is apparent on

almost every page. Moreover, though in principle having the role of a treaty, its status in the domestic law of most countries is in practice very weak and the interpretation of its provisions has been largely a matter for the governmental descendants of those diplomats who drafted it.

Even casual observation reveals that the two cornerstones of that agreement are these days honoured mainly in the breach. Non-discriminatory tariffs have become largely irrelevant in today's 'new' protection systems, which depend on 'domestic' subsidies, 'voluntary' restraint agreements and the discretionary application of 'unfair' trade rules. The contractual core of the GATT has become moribund.

But the malaise is equally apparent in the negotiating mode of the institution. The traditional reciprocal trade bargaining process has been aptly described as a world of 'requests'. Each country approaches trade negotiations with a pretty clear idea of what it wants from other countries, but very little idea about what liberalisation strategy it should pursue domestically. In fact, most governments work out their 'concessions' only in response to the requests of their trading partners. In this situation, trade diplomats are inevitably forced into a defensive attitude - trying to 'give away' no more than the minimum necessary to achieve foreign gains. They act as if they believe that exports are the only gain, and imports the pain, from trade negotiations.

From an economy-wide perspective, this attitude is nonsense and clearly damaging to the interests of each nation. From the perspective of particular uncompetitive industries, however, it makes a lot of sense. The mercantilist approach to trade negotiations, and the rise of the new protectionism, are proof that government policy has been shaped more by sectional perspectives than a truly national one.

Governments, by their actions, appear to have lost the ability to abide by international commitments which they acknowledge to be in their

collective interests; in other words, they have lost control of their policy agendas. Trade 'policy' - and I use the word advisedly - seems to have become the almost accidental by-product of a process of accommodation of domestic pressure groups.

But this development has itself been no accident. It reflects a systematic bias in the domestic policy-making environments of GATT member countries. That bias occurs on both the 'demand' and the 'supply' sides of what has come to be called the political market for protection.

First, on the demand side, there is the long-recognised imbalance in the demands on government to redistribute income from large to small groups within society. This phenomenon has been rigorously analysed in the modern political economy literature, but it is really just a matter of common sense. In each particular decision on protection, the potential gainers individually have much at stake, while the potential losers individually have little - even though the aggregate redistribution of income and the cumulative cost to the economy, may be very large. As a result, adjustment-averting producers are able to overcome free-rider obstacles to effective collective action, but consumers and taxpayers are not.

This inherent imbalance in the 'demand for protection' is compounded by the fact that uninformed public opinion frequently supports vested interests, either based on illusions of a 'free lunch', or because the conflict is seen as being between the interests of a national group (local enterprises and their labour forces) and 'foreigners'. Such misconceptions are understandable, for the economic principles involved are not intuitively obvious. What's more, the spokesmen for industry have an incentive to foster misconceptions about protection and in this they are aided by the human-interest perspective of the popular press.

Imminent job losses and factory closures make much better 'copy' than complicated arguments about the damage to job opportunities in other

occupations and industries which protectionism engenders.

So Government will normally be under pressure to grant protection to producer groups. This is a fact of political life and always has been. In itself it need not explain the loss of GATT's effectiveness. But there is a second aspect to consider.

It is not generally appreciated that in most countries the imbalance in the demand for protection is compounded by government administrative arrangements which actually favour the claims of sectional interests: in other words, that there is also a systematic bias on the supply side of the protection 'market'.

In most countries, government administrations are divided into numerous departments, many established primarily to provide a communication link between government and various interest groups. In such departments, a symbiotic relationship naturally develops with their 'client' groups, the existence and growth of each being to some extent interdependent. In a sense, a part of the bureaucracy becomes an extension of the private special-interest group. This doesn't mean that the public servants are behaving improperly; only that the 'public' whose interests they are serving is a rather narrow segment of the whole. Where that segment of the public is an industry seeking protection against imports, the main source of advice available to government in evaluating its claim is normally the very department with which it is associated. The result is equivalent to a shopkeeper asking the Mafia's lawyer for advice about whether to pay protection money!

To take an example of particular importance to Australia and New Zealand, the EEC's Common Agricultural Policy has evolved into the monster it is today for some very good bureaucratic reasons. Agricultural 'policy' in the EC - and again I use the term advisedly - is essentially made by the representatives of national Departments of Agriculture, meeting in splendid isolation in Brussels. This - together with the need for consensus (ie. the triumph of the least-best) -

clearly biases the range of possible outcomes. It also provides a convenient means by which each Minister can return to his domestic colleagues blaming the cost of protectionist policies on the others.

In sum, administrative arrangements have a vitally important effect on policy outcomes. They not only influence the government's response to protectionist demands, but also the nature and extent of those demands. If government creates an institutional environment which raises the expected return to rent-seeking, it is only to be expected that the demand for assistance will respond.

For reasons identified by Mancur Olson, there has been a steady growth in pressure groups during the relatively stable period since GATT was formed. This has been matched by rapid growth and increased fragmentation of government bureaucracies - for reasons best described by Northcote Parkinson. The result is that GATT's influence has been continuously eroded. And as the power of precedent asserted itself, this has turned into a rout.

Instead of GATT rules influencing trade policy, the opposite situation has now been reached, in which domestic policy outcomes determine how governments interpret their GATT obligations. In some cases, they have found suitable GATT 'cover'. (Anti-dumping is very much in vogue in my country, I don't know about yours). In other cases, the GATT rules were suspended - agriculture and textiles and clothing are good examples. In yet others, governments simply summoned a hitherto unsuspected ingenuity in devising trade restrictions that evade GATT disciplines altogether. I am speaking here of so-called voluntary restraint arrangements.

It follows that Government policies will continue to diverge from GATT principles, and trade negotiations will continue to achieve only the illusion of progress, as long as the overwhelming bias in favour of claimant industries remains.

Governments can do little about the superior organisational ability of industry lobbies. But they can ensure that administrative processes do not load the dice in these groups' favour. And they can also ensure that those groups in the community who bear the costs of protection are better informed. Olson describes this information about industry interventions as a collective good. If so, it is one of the few collective goods that an expanding government bureaucracy has neglected to supply.

It seems indisputable that a proper understanding of the economy-wide effects of protection is a necessary precursor for durable reform. What is obviously also desirable is that this understanding can be achieved without the sort of economic experience of the 1930s. Subsequent history has shown that even understanding borne of adversity can be lost. People learn their lessons, but then they forget them again. The problem is a continuing, systematic one, requiring an institutional solution.

At this point, I am starting to feel that I am preaching to the converted. The New Zealand government was clearly convinced of the need for a more systematic, economy-wide scrutiny of industry interventions when it established the Economic Development Commission last year. And, in Australia, the Industries Assistance Commission has been generating information on, and advising the Government about industry assistance since 1974. I think that we have some progress to show for that - although it has been painfully slow at times and not always in the most desirable direction.

But consider the situation in those agricultural subsidising countries that are causing efficient primary exporters so much difficulty. Policy-making in the EC is characterised by an almost total absence of public scrutiny and debate. The first information on the economic consequences of the CAP that most Europeans ever saw was produced in 1985 by the Bureau of Agricultural Economics in Australia! A similar situation exists in Japan; while in the United States, much policy is

shrouded in a legalistic haze that obfuscates the effects of, and lends an unwarranted legitimacy to, policies that have nothing to do with the interests of the American community as a whole.

It is difficult to believe that any multilateral progress can be made on agricultural reform (or anything else for that matter) without general acceptance in the countries concerned of the national benefits of that reform.

It is true that the Uruguay Round has placed agriculture squarely on its agenda. And I think that the Cairns Group helped achieve that. But this will not be the first GATT negotiations to try to liberalise trade in agriculture. Both the Kennedy and Tokyo Rounds tried and failed.

The Ministerial commitment in the Uruguay Declaration to negotiate on agriculture, while not explicitly qualified (as in the Tokyo Declaration), nevertheless contains sufficient ambiguity to permit quite different interpretations of its objectives by the major countries involved. Indeed, both Australia and the European Community found it necessary to provide their own interpretations at the conclusion of the Ministerial Session. It is not reassuring that M. De Clercq took this opportunity to reaffirm that the Community's 'fundamental common policies and mechanisms are not up for negotiation'.

Whether substantive liberalisation actually eventuates, will be determined - as in the past - by the perceptions of national interest that each country takes to the negotiating table.

The price-support policies that are behind our countries' export problems are very costly to those countries that practise them. It is from the widespread recognition of that fact within those countries, rather than from diplomatic pressure, that genuine reform is most likely to emerge. The recent attempts to modify the CAP and to reduce agricultural production in the United States have stemmed from the

domestic difficulties caused by these policies. While these moves have been motivated more by budgetary than efficiency concerns - and therefore need not be significantly trade liberalising - they are a beginning. What has been lacking from multilateral negotiations has been a search for ways of facilitating such domestic recognition, within the countries responsible for trade distorting policies, of the need for reform in their own national interest.

The importance of this issue is beginning to be recognised internationally. A promising initiative has been under discussion by a study group organised by the Trade Policy Research Centre in London, and chaired by Olivier Long, former Director-General of the GATT. In its forthcoming report, that group proposes that GATT members use the opportunity provided by the Uruguay Round to negotiate an agreement on 'domestic transparency'. Under the envisaged agreement, each government would designate an independent body with a broad mandate to publicly report on all forms of industry assistance from an economy-wide perspective. Its activities would be purely advisory. It would not have any executive or judicial power. Its role would be confined to improving the quality and public availability of policy-relevant information.

In the GATT context, this constitutes quite a new approach to a long-standing problem. It has been advanced in order to correct the perceived weakness of the adversarial approach to multilateral trade negotiations, in which each participant has sought to gain concessions at the expense of others. The Study Group is basing its proposal on the following propositions: that the important trade barriers are increasingly in non-tariff forms, which have traditionally been viewed as part of domestic policy; that because outsiders usually cannot see them, those barriers cannot be brought into account in international negotiations unless governments imposing them choose to place them 'on the record'; and that their motivation for doing so must be to enhance domestic welfare rather than to make concessions sought by foreigners.

While it is to be expected that vested interests will oppose such an initiative, most governments should not. To the extent that they have had difficulty in resisting pressures for policies that they know to be contrary to their long-term objectives, they should welcome the greater opportunity that it would provide for broader political support.

The trade problems faced by both Australia and New Zealand have their origin in the domestic policy environments of our trading partners. As presently constituted, the multilateral trade negotiations do not address this fundamental problem. The purpose of promoting a domestic transparency initiative in GATT is to provide a constructive, domestic underpinning to the negotiations. Without it, the Uruguay Round might just sink into the swamp.

REFERENCES

Gary Banks, 'Vested Interests, Domestic Transparency and International Trade Policy', Intereconomics, May-June, 1984.

Bureau of Agricultural Economics, Agricultural Policies in the European Community, Policy Monograph No. 2, (Canberra, 1985).

W.B. Carmichael. 'National Interest and International Trade Negotiations'. The World Economy, December 1986.

GATT, 'The Uruguay Round', Focus: Newsletter, October 1986.

Olivier Long et al. Public Scrutiny of Protection: A Report on Domestic Policy Transparency and Trade Liberalisation, Trade Policy Research Centre, London, December 1987

Mancur Olson, The Rise and Decline of Nations (New York: Yale University Press, 1982).

C. Northcote Parkinson, Parkinson's Law, or the Pursuit of Progress, (London, John Murray, 1958).

Jan Tumlrir, Protectionism: Trade Policy in Democratic Societies, (Washington, D.C., American Enterprise Institute, 1985).

STATE OWNED ENTERPRISES: CORPORATISATION 'A MASSIVE HOAX'

Colin Hicks, President, Public Service Association

The Government has justified its drive to convert state departments into corporations, to contract out state services and to shift to a user-pays basis of provision of service on the grounds that this will:

- improve efficiency in the provision of services;
- promote accountability for the delivery of service and for managerial performance.

The superficial attraction of improved efficiency and accountability has led to a number of organisations giving this programme explicit support. The problem is that corporatisation has in fact got virtually nothing to do with either efficiency or accountability.

Accountability - of either managers or Ministers, to Parliament specifically and to the public generally, has been obviously and substantially diluted. We have created a commercial screen to shield state enterprises from public scrutiny. Instead of making the secret world of private commerce more accountable to the communities, consumers, and workers from whom they profit, corporatisation has shifted vast areas of resource use and pricing of services behind the closed doors to corporate board rooms.

The pace and form of corporatisation has also dislocated the management and personnel operational routines of the previous departmental organisation and there is a growing inefficiency now becoming apparent within most of the corporations.

Instead of upgrading the management information and control systems of the public sector and then looking at what organisational changes were needed to improve efficiency, the Government went about things completely the wrong way around. It changed the organisational structure and management systems and is now scrambling around trying to find financial structures and monitoring systems to apply to those new life forms.

Massive Hoax

The corporatisation exercise has been a massive hoax. It has been a guise for three things:

- converting service deliverers into subtle forms of tax gatherers;
- cutting back the range and depth of services;
- ending cross-subsidisation of public sector pricing, particularly of electricity, postal and telecommunications services.

Corporatisation is about redistributing income, not about improving efficiency. The losers will be:

- public sector workers;
- small scale, remote consumers;
- consumers in areas that are high cost to service.

I have heard farmers say that they support corporatisation, but oppose increasing rural delivery charges, and higher electricity and phone charges for provincial or rural consumers. They can't sustain that position. corporatisation is precisely about increasing those charges and allowing a redirection of resources towards high profit, high growth areas of the economy.

There has not been enough recognition of the impact of a new public sector price regime on agricultural costs and incomes, and of the flow-on effects of this.

The Next Wave

More importantly I do not think agricultural economists have given enough thought to the likely sectoral impact of the next wave. This is likely to involve:

- Cuts in MWD input into developing and maintaining the provincial infrastructure, particularly where this activity does not generate commercial returns.
- A major shift in information, training and advisory service costs onto individual or industry users. Because the agricultural sector is a relatively high user of government-sourced services of this kind, it will be the main victim of the change.
- Reductions of research activity into new products, production techniques, and markets. The form of organisation in the agricultural sector, based as it is on the family-farm concept, means that the sector is not well placed to compensate for cuts in those sorts of services.

It is time to get away from simplistic theory and catchy political sloganeering about corporatisation. Careful study shows it up to be a badly thought out process that was implemented back to front and that benefited the better off sectors of society. At a very minimum we should learn from the past and not compound the error in the future through further rounds of corporatisation. In addition, we can reintroduce proper service requirements and public scrutiny mechanisms on the corporations that have been created.

MARKET DIVERSIFICATION AND RISK IN NEW ZEALAND

EXPORT LAMB MARKETS¹

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SUMMARY

This paper evaluates the export lamb diversification scheme established by the New Zealand Meat Producers' Board and considers the implication of the policy for variability in producer returns. By using simple measures of market diversification, it is concluded that the policy has been successful both in reducing dependence on the United Kingdom market, and in diversifying lamb exports across a number of markets.

However, diversification of lamb exports appears to have been associated with increasing levels of risk, as measured by the variability in returns received. Therefore, alternative allocation procedures which minimise risk were considered, and the implications of such risk minimisation for the level of diversification commented on.

Key Words: Lamb exports, diversification, concentration, risk, optimal allocation, quadratic programming.

INTRODUCTION

Initially fuelled by a desire to expand New Zealand's export lamb markets, and then faced by a fear of drastic falls in demand as a result of the United Kingdom joining the EEC, the New Zealand Meat Producers' Board, in 1966, initiated a formal scheme to diversify the markets to which New Zealand export lamb was being sent. This was achieved through government legislation in the form of the Meat Export Control Amendment Act of 1966, and provided that a target percentage of lamb be exported to markets other than the United Kingdom. Levies were imposed to penalise those unable to achieve these targets. Target percentages were set at 10 per cent for the 1966/67 year, and were gradually

¹The authors are indebted to their colleagues, Professor Tony Zwart, Mr Bert Ward and Dr Alistair McArthur for their constructive advice, assistance and criticism during this research.

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increased to 32 per cent by 1979/80 when the scheme was formally suspended.

Such market diversification has also been practised in a number of other New Zealand industries in the past. The techniques for achieving targets have varied, but the objective appeared to be similar in each case; that is, to reduce the dependence on a single export market. Given the popularity of such schemes, it would seem to be imperative to evaluate them in terms of their stated objectives, and to consider some of the consequences of successful diversification policies.

In this paper, the export lamb diversification scheme established by the New Zealand Meat Producers' Board is evaluated in this way, and the implications of the policy for variability in producer returns is examined.

MARKET DIVERSIFICATION OVER TIME

The simplest method of evaluating the lamb diversification scheme is to determine whether export performance exceeded the targeted proportions envisaged. By this criterion, the scheme must be regarded as successful since performance did indeed exceed the targets in all but four years.

Alternatively, the proportion of lamb exported to the United Kingdom market over time can be calculated, and a judgement made on whether dependence on this market has been reduced. It can be seen from Figure 1 that over 90 per cent of New Zealand lamb exports in 1964 were destined for the United Kingdom. However, by 1984 just over 20 per cent of total lamb exports were being sent to this market. Whether such a reduction in dependence on the United Kingdom could have occurred without the lamb export diversification scheme is open to speculation. On balance though, it seems reasonable to conclude that the scheme was, at the very least, partially responsible for reducing the dependence of lamb exports on the United Kingdom market.

Although lamb was successfully diverted from the United Kingdom market, the possibility that dependence on one market was traded off for dependence on another market should not be discounted. The extent to which the product normally destined for the United Kingdom market is diverted to a range of markets rather than another single market can be appropriately encapsulated in a market concentration index. A simple market concentration index for a particular year is given by

$$C = \sum_i X_i^2 \quad (1)$$

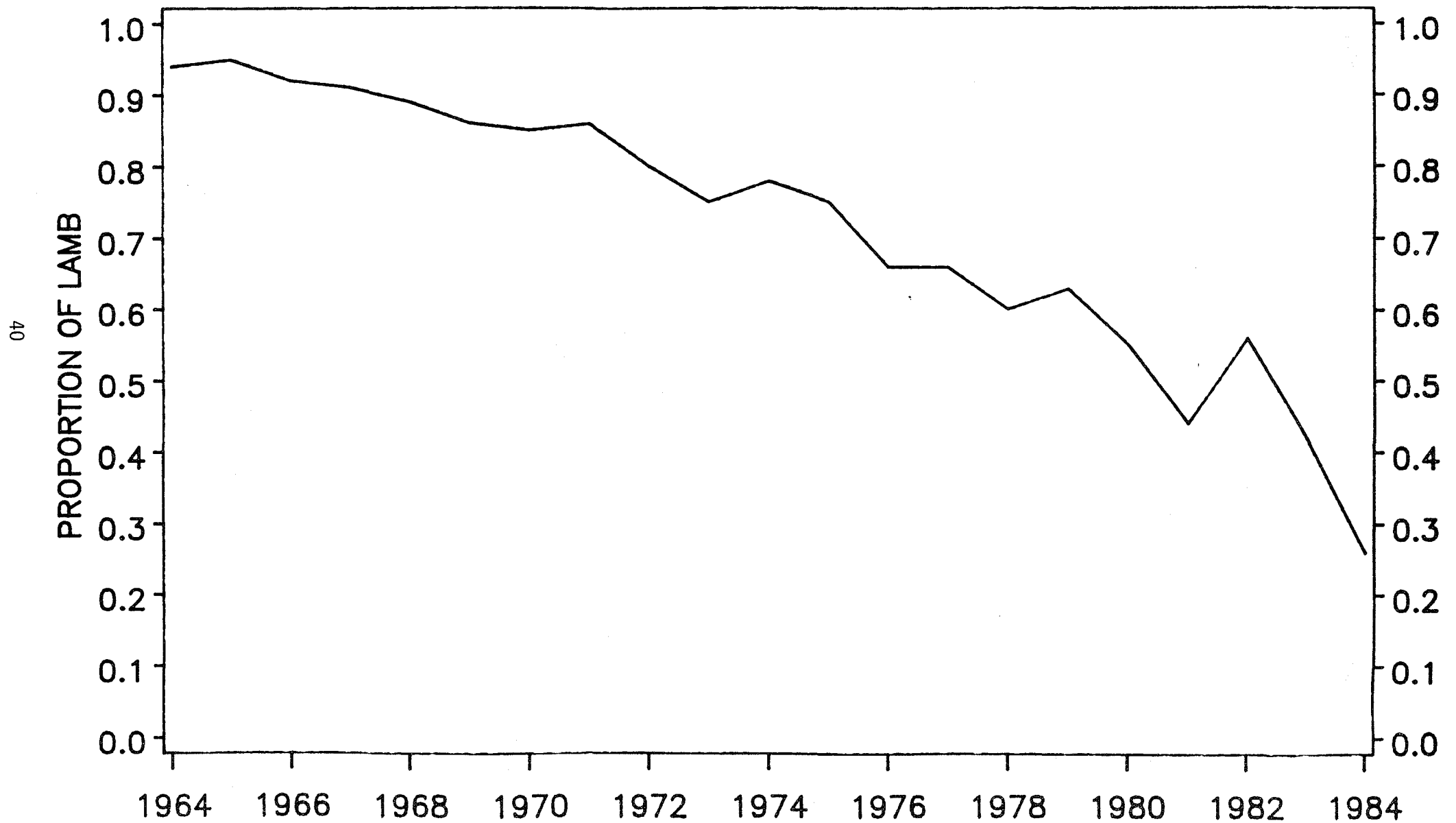
where C is the market concentration index, and

X_i is proportion of exports of the commodity (quantity) to market i

This particular index was also used by Gould (1985) when he examined market diversification of total New Zealand exports. This measure not only takes into account the number of markets

Figure 1

PROPORTION OF TOTAL N.Z. LAMB EXPORTS TO THE U.K. (by weight)



exported to, but the proportion of exports sent to these markets. Hence, a market is considered more diversified if it sends 5 per cent of its total exports to each of its 20 markets rather than 90 per cent to one market and the remaining 10 per cent to the 19 other markets. The value of the market concentration index, C , can range from close to 0.00 when markets are highly diversified to 1.00 when all product is exported to one market. Indices were calculated for each year over a 20 year period from 1964, and the results plotted in Figure 2. This shows that not only did the dependence of lamb exports on the United Kingdom market lessen, but diverted product was spread around a number of markets. Therefore, by this criterion also, it must be concluded that New Zealand has substantially diversified its export lamb markets.

LEVELS OF RISK OVER TIME

Lamb market diversification has obviously been successful in reducing dependence on the United Kingdom market and in spreading significant quantities of product across a number of markets. However, it is not clear whether there were any disadvantages associated with the policy which are not evident in the more crude measures of evaluation considered above. In order to investigate this possibility further, parallels were drawn with the literature on financial markets, where portfolio diversification, which is analogous to market diversification, has long been a source of considerable interest to financial analysts.

In the financial literature, the simple concentration index, C , which was used above, would be referred to as a measure of naive diversification. The so-called naivety is said to arise because the measure merely computes the extent to which the number of markets (appropriately weighted) increases, but takes no account of the consequences of alternative portfolio diversification strategies on expected returns and the risk associated with these returns. That is, a diversification strategy which is characterised by a concentration index of 0.3 would be considered to be more successful than one with an index of 0.4, even where the former strategy was associated with lower real returns and greater risk than the latter.

Real returns for New Zealand lamb producers (F.O.B. unit price per kilogram divided by a sheep farmer's input cost index) over the period 1964 to 1984 are shown in Figure 3. Although these returns have obviously been quite variable, this graph suggests that there has probably been no significant increase or decrease in real returns over time. Hence, it would appear that the lamb diversification scheme has not been associated with undesirable consequences in this regard, although it must be recognised that producer returns are obviously influenced by a number of factors.

Before considering any association between diversification and risk, a measure of such risk must be determined. In the financial literature, risk is defined as the variability in returns exhibited by securities. This has direct parallels to

Figure 2
DIVERSIFICATION OF N.Z LAMB EXPORTS

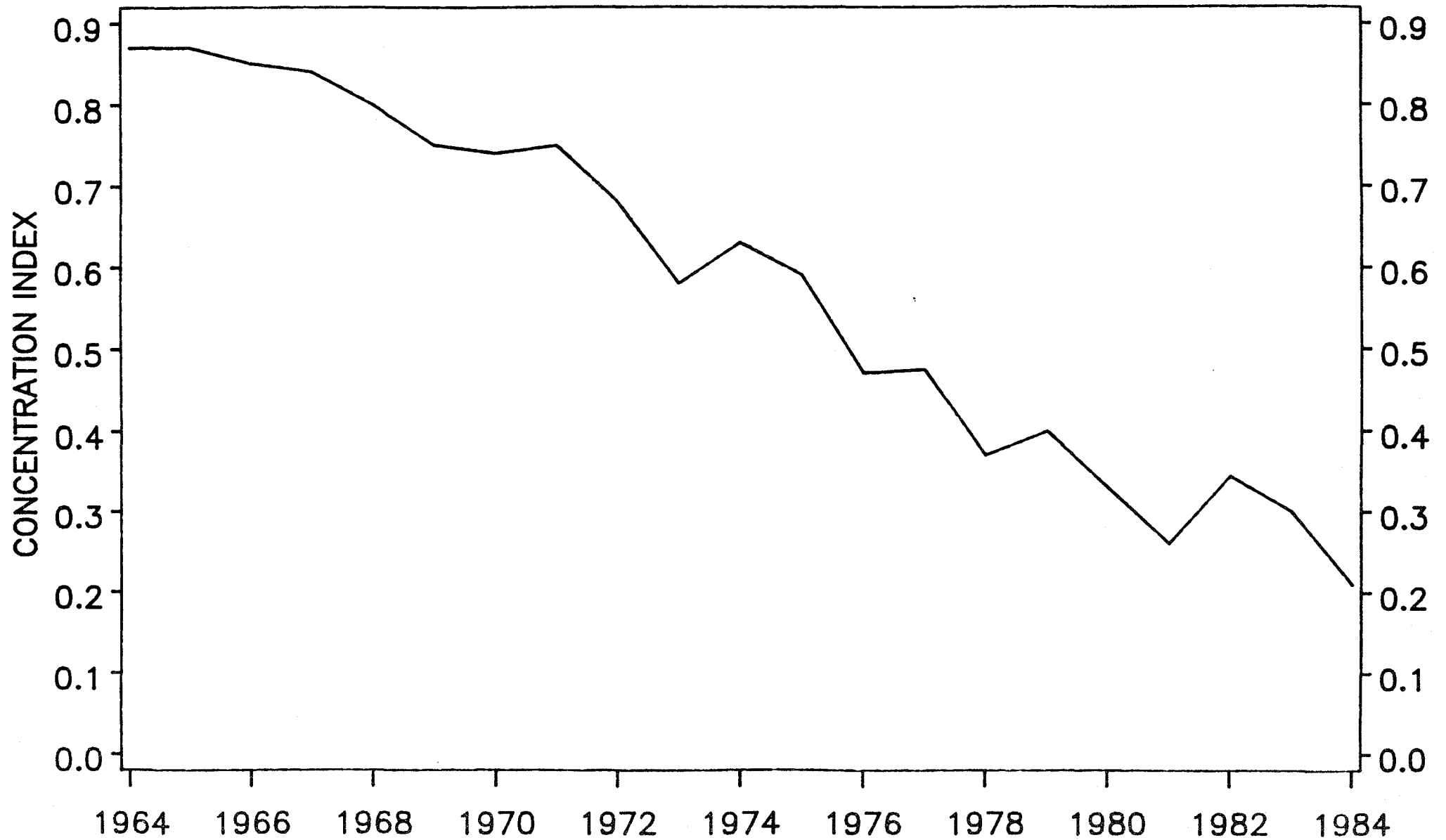
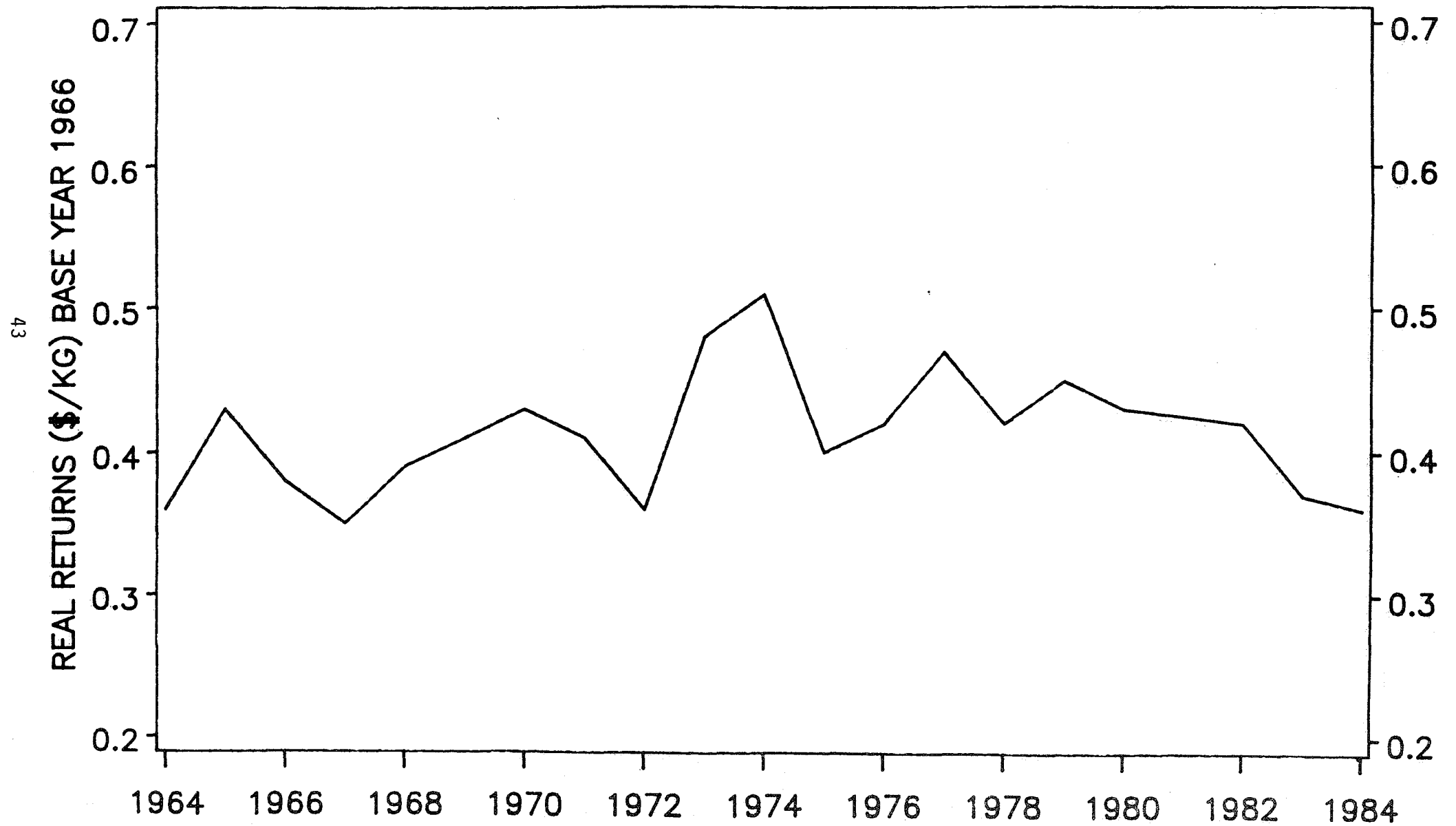


Figure 3
REAL RETURNS OF N.Z LAMB EXPORTS



lamb markets, where markets exhibiting large variations in returns would be considered more 'risky' than those with lower variations. Markowitz (1959) derived a measure of such risk

$$\text{Var}(rp) = \sum_{i=1}^n \sum_{j=1}^n \omega_i \omega_j \sigma_{ij} \quad 3 \quad (2)$$

where $\text{Var}(rp)$ is a measure of total portfolio risk

n is the number of securities

σ_{ij} is the co-variance of returns of i and j ($i=j$, $j=i$)

σ_{ii} is the variance of i ($j=i$)

σ_{jj} is the variance of j ($i=j$)

ω_i is the proportion of security i

ω_j is the proportion of security j

This measure can be suitably adapted by treating markets as securities, and the overall distribution of lamb exports as a portfolio.

Data required to calculate this measure of risk, $\text{Var}(rp)$, are estimates of expected returns for all markets under consideration. This was obtained by dividing the unit price per kilogram for lamb (f.o.b.) by a sheep farmers input cost index to give an approximation of real returns to the producer gross of processing and handling charges.

The expected variances and co-variances were then calculated using this data.

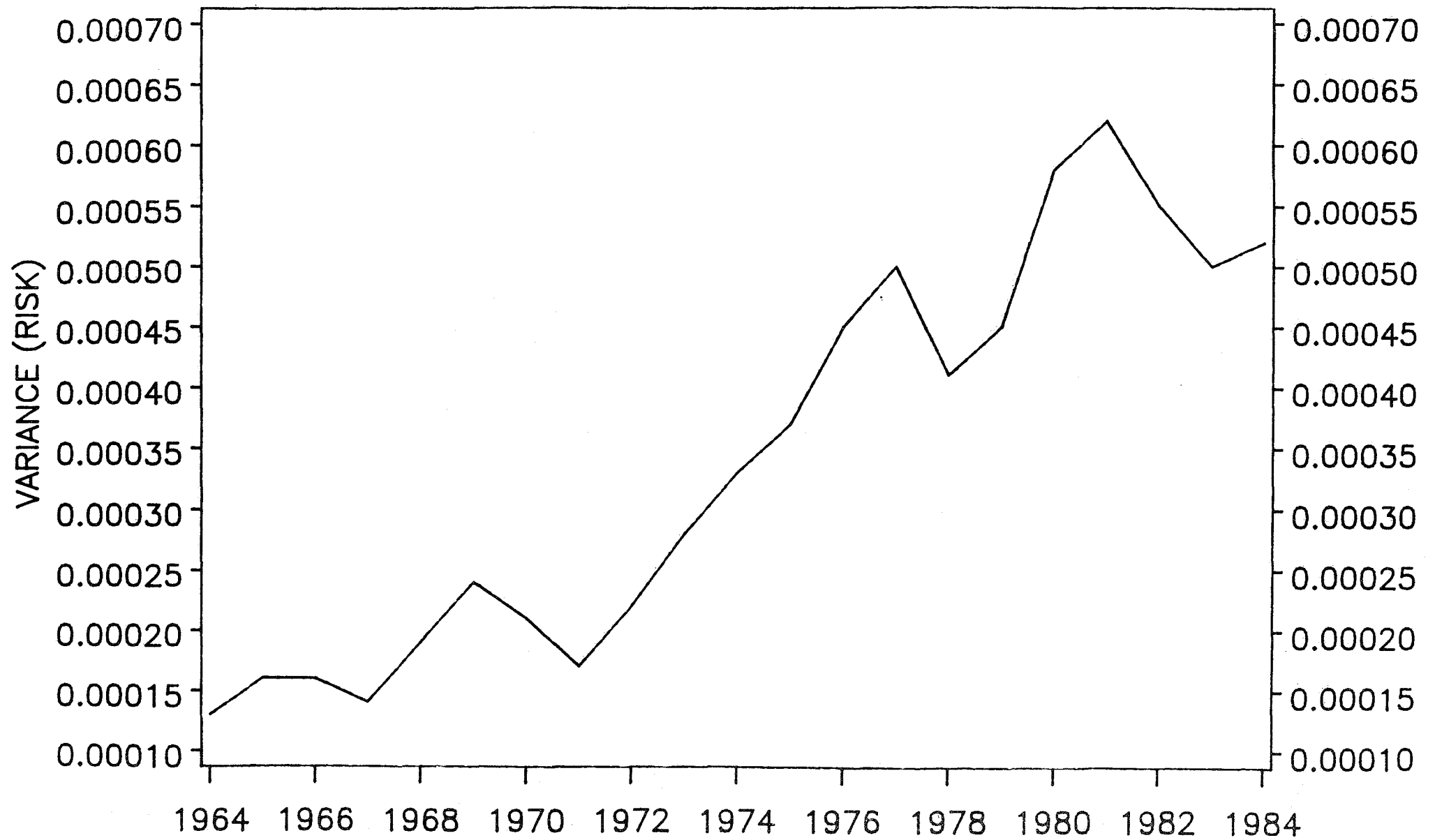
The resulting measures of risk are plotted in Figure 4. This shows that the level of risk associated with the distribution of lamb exports between markets increased over the 20 year period in question. Therefore, although the successful diversification of lamb away from the United Kingdom market does not appear to have been obviously associated with any increase or decrease in producer returns, there is evidence to suggest that this diversification has been associated with increasing levels of risk as measured by the variability in these returns.

OPTIMAL LAMB EXPORT ALLOCATIONS WHICH MINIMISE RISK

The finance literature would suggest that not only does portfolio analysis imply diversification, it implies the right kind of diversification (Markowitz 1959). In other words, if increased risk is undesirable, then diversification strategies should take this into account. This paper concludes by considering whether the overall risk associated with variable returns could have been reduced by an alternative allocation of lamb exports between markets. In other words, what market allocation of lamb exports

³A formal derivation is available from the author upon request.

Figure 4
A MARKOWITZ MEASURE OF RISK



would minimise risk subject to a given return and/or a maximum quantity being sent to a particular market?

Quadratic programming algorithms have been found to be useful for handling problems where such constraints are required, and this technique is used to evaluate alternative market allocations of lamb which could have been made in 1984. The quadratic programming algorithm iteratively minimises a quadratic objective function subject to appropriate linear constraints. In this case, the objective function would be equation (2). Recall that

$$\text{Var}(rp) = \sum_{i=1}^n \sum_{j=1}^n w_i w_j \sigma_{ij}$$

where $\text{Var}(rp)$ represents the measure of risk and other variables are as previously defined.

This function was minimised subject to the constraint that the overall return for lamb exports be equal to the 1984 level of \$2.02/kg. Alternative constraints on the ability to reallocate output were then considered. The first two scenarios allowed the proportion of lamb allocated to each market to increase by 5 per cent and 10 per cent respectively above the 1984 proportion, if this was appropriate. The final two scenarios allow for the possibility of these 5 per cent and 10 per cent increases while keeping the United Kingdom market proportion at its 1984 level of 26 per cent (which was the lowest proportion the United Kingdom was supplied over the 1964-84 period).

The results of this optimisation process under these various scenarios are seen in Table 1. In all scenarios, exports to Iraq, Papua New Guinea, the U.A.E. and the U.S.A. cease, and exports to Fiji and Saudi Arabia are reduced. In fact, the analyses suggest that Iran is the only Middle Eastern market which should be maintained as a viable export market when proportion constraints are relaxed.

The total risk associated with these alternative allocation procedures was calculated and compared with the actual risk experienced in 1984. This is illustrated in Figure 5. Under scenario A, where all markets are able to take proportionately 5 per cent more lamb than was taken in 1984, total variance could be reduced 20 per cent on the level of risk measured in 1984. A 10 per cent relaxation in all markets sees a 31 per cent decrease on the 1984 level, while in scenarios C and D (5 per cent and 10 per cent relaxation in all markets other than the United Kingdom) risk could have been reduced by 16 per cent and 27 per cent respectively.

? The concentration indices associated with the alternative allocations were also calculated and plotted on Figure 5. These show that the concentration indices remain at much the same level as risk is reduced. This highlights the dangers which may be inherent in these more simple measures of diversification, if it is implicitly assumed that diversification is associated with reduced risk. There are obviously limitations associated with the analysis presented in this paper and appropriate caution should be exercised when interpreting the results which have been

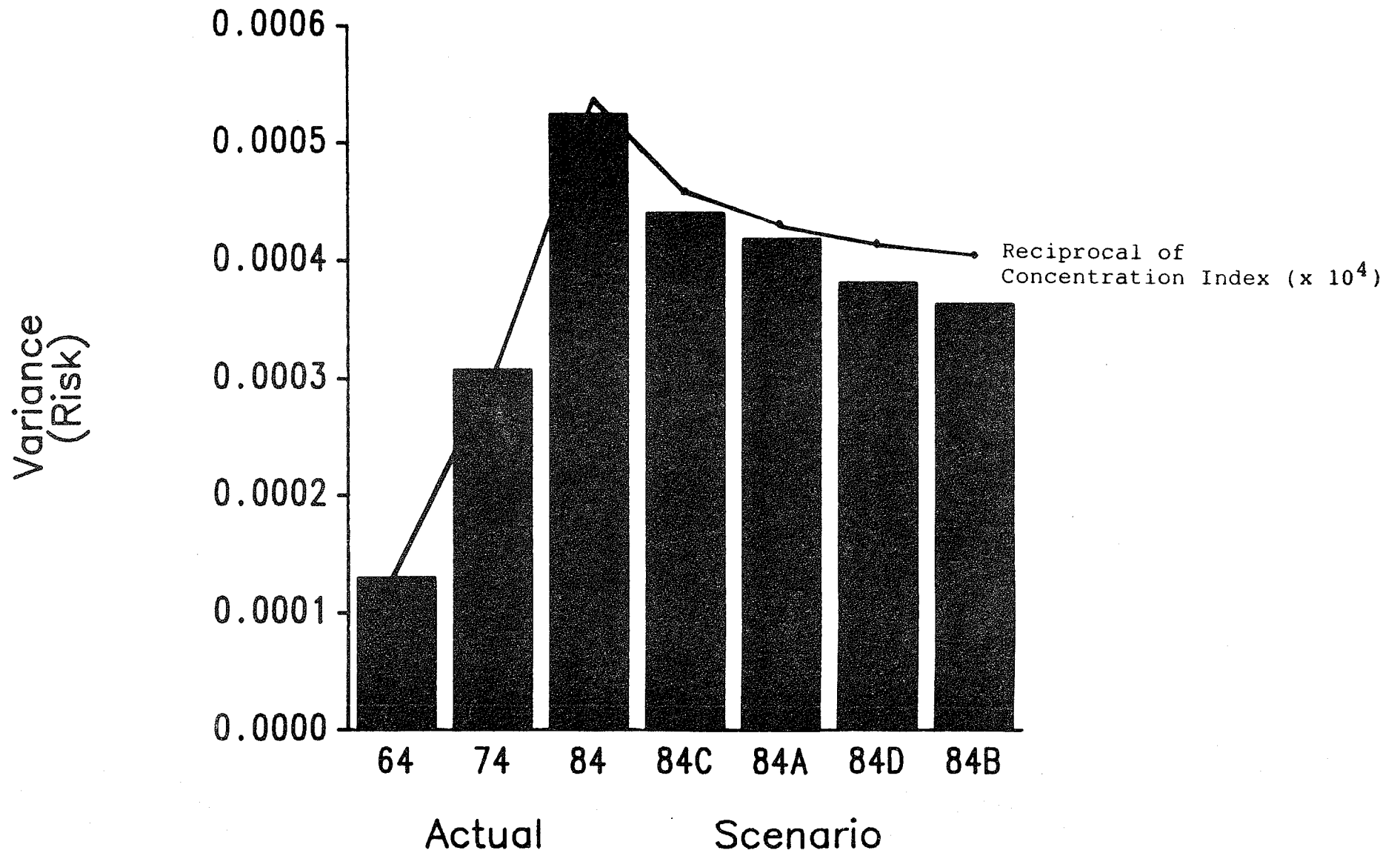
↓ increase marginally when risk is reduced.

TABLE 1

OPTIMAL ALLOCATION OF LAMB EXPORTS UNDER FIVE SCENARIOS

<u>Country</u>	<u>Actual 1984 Export Proportion</u>	<u>Scenario A.</u>	<u>Scenario B.</u>	<u>Scenario C.</u>	<u>Scenario D.</u>
		<u>All 5% greater than 1984</u>	<u>All 10% greater than 1984</u>	<u>U.K. at 1984. All else 5% greater.</u>	<u>U.K. at 1984. All else 10% greater.</u>
E. Carib.	0.0000	0.001	0.00000	0.0010	0.00000
Belgium	0.0031	0.003	0.00341	0.0030	0.00341
Canada	0.0127	0.013	0.00449	0.0130	0.01397
Cyprus	0.0024	0.003	0.00264	0.0030	0.00264
Denmark	0.0038	0.004	0.00000	0.0040	0.00196
Fiji	0.0080	0.007	0.00000	0.0070	0.00091
France	0.0080	0.008	0.00880	0.0080	0.00880
Fr. Polynesia	0.0013	0.001	0.00143	0.0010	0.00143
Germany FDR	0.0170	0.018	0.01870	0.0190	0.01870
Greece	0.0243	0.025	0.02673	0.0250	0.02673
Iran	0.3234	0.340	0.35570	0.3400	0.35570
Iraq	0.0001	0.000	0.00000	0.0000	0.00000
Italy	0.0101	0.011	0.01111	0.0110	0.01110
Japan	0.0427	0.045	0.04697	0.0450	0.04697
Jordan	0.0107	0.011	0.01177	0.0110	0.01177
Netherlands	0.0016	0.002	0.00000	0.0020	0.00000
P. New Guinea	0.0142	0.000	0.00000	0.0000	0.00000
Saudi Arabia	0.0251	0.008	0.00000	0.0240	0.00000
Singapore	0.0029	0.003	0.00319	0.0030	0.00319
Switzerland	0.0029	0.003	0.00319	0.0030	0.00319
U.A.E.	0.0043	0.000	0.00000	0.0000	0.00000
United Kingdom	0.2505	0.265	0.27555	0.2505	0.25050
U.S.A.	0.0139	0.000	0.00000	0.0000	0.00000
Other Countries	0.2173	0.228	0.22633	0.2280	0.23903
Total	1.0000	1.000	1.00000	1.0000	1.00000

FIGURE 5
RISK ACHIEVABLE UNDER VARIOUS SCENARIOS



presented. For example, in the quadratic programming problem, it was assumed that all markets exhibit perfectly elastic demand curves up to their quantitative constraints, that there is control of the distribution of lamb destined for overseas markets, and that lamb is an homogenous product.

However, the research does suggest that attention should be paid to both stated objectives and acceptable tradeoffs when initiating and evaluating such schemes, and that the measures used for evaluation should appropriately reflect these objectives and tradeoffs.

REFERENCES

Gould, J. (1985) The Muldoon Years, Hodder and Stoughton, Auckland.

Markowitz, H.M. (1959) Portfolio Selection - Efficient Diversification of Investments, John Wiley and Sons Inc., New York.

New Zealand Meat Producers' Board Annual Reports 1960-1984.

Statistics Department External Trade Statistics 1965-1984.
Department of Statistics.

SHEEPLAN AND USER PAYS¹

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SUMMARY

This study examines the benefits of Sheeplan and its redevelopment by measuring changes in consumer and producer (commercial sheep farmers) surplus. A distinction between the immediate incremental gain and the cumulative gain is recognised, because the genetic improvements stemming from the use of Sheeplan are inherited from one generation to the next. The majority of the benefits accrue to producers. A user pays scheme to charge ram breeders to fully recover the Sheeplan dedevelopment costs is bearable to ram breeders and commercial sheep farmers in the long run. However, when output prices deteriorate the immediate incremental gain may be small and farmers with cash problems may drop out of Sheeplan.

Key words: Sheeplan, producer and consumer surplus, user pays, genetic improvement, incremental gain, cumulative gain.

INTRODUCTION

Selecting rams is an important economic decision for sheep farmers. Farmers can improve their profitability of sheep farming by using selection strategies based on characters of economic importance. The National Flock Recording Scheme (NFRS), introduced in 1967, enabled farmers to select rams based on a single trait selection scheme.² Sheeplan, introduced in 1976 to replace NFRS, has enabled farmers to select rams based on a weighted index of: (1) Number of lambs born or reared; (2) Lamb weaning weight; (3) Hogget liveweight; and (4) Hogget fleece weight.

NFRS and Sheeplan have helped commercial farmers select breeders and rams. Breeders have also benefited from the selection scheme because commercial sheep farmers have been willing to pay premiums for Sheeplan recorded rams over non-recorded rams (Lysaght, 1986). Furthermore the scheme has improved the genetic merit of the national flock because the genetic improvement achieved by breeders and sheep farmers is transmitted to future generations.

Currently MAF and the Sheeplan Council are contemplating a redevelopment of Sheeplan to be implemented in 1989/90. The improved scheme would provide higher genetic gain by improving breeding value accuracy, allowing for adjustment for non-genetic factors, and increasing

¹This paper is abridged from the author's "Economic Analysis of Sheeplan and Its Redevelopment", Economics Division, MAF, Technical Paper 6/86.

² There are two traits on which they could select - reproduction and fleece weight - but both were selected independently.

the effectiveness with which Sheeplan records are used. (Bell, 1985; Callow, 1986). Due to a policy change toward the commercialisation of marketable research findings and service (User Pays System), this redevelopment needs to be financially justifiable.

MAF is planning to estimate the costs of research, development and maintenance of the proposed Sheeplan redevelopment; to assess the benefits associated with the redevelopment; and, more importantly, to identify the beneficiaries and to incorporate a user fee scheme to recover at least part of the costs, if not to generate profits.

The objective of this study is to estimate the benefits that can be generated by Sheeplan and its redevelopment. A theoretical model is developed to measure the changes in economic welfare of those affected in the sheepmeat and wool markets. The concepts of consumer surplus and producer surplus form the foundation of this analysis.

WHO ARE THE BENEFICIARIES

Two groups are affected by Sheeplan: (1) producers of sheepmeat and wool, including the direct users of the scheme, (ram breeders), and the indirect users, (commercial sheep farmers), and (2) consumers of products such as sheepmeat and wool fibres. The physical benefits of the scheme come in the form of more output per unit of input (or less input per unit of output) and/or improved output quality. If the marketplace can absorb all of the future flow of the increased output at a constant price, computing the benefits is straightforward. However, markets rarely behave this way. Oftentimes, market prices of a product will drop due to a supply increase, other things being unchanged. In this manner, consumers will also benefit from the scheme.

The benefit is the sum of the net consumer surplus gain and the net producer surplus gain. Because over 90 percent of New Zealand sheepmeat and wool are exported every year, the foreign consumer surplus gain has to be subtracted from the total consumer surplus change in order to derive the New Zealand consumer surplus gain. Therefore, the net New Zealand gain due to the scheme is the sum of the increased producer surplus plus the New Zealand consumer surplus gain.

The gain in producer surplus can be used to approximate the upper limit of the charges that users of the scheme would be prepared to bear. The change in benefits to commercial sheep farmers, (the indirect Sheeplan users), represents the upper limit of their aggregate willingness to pay for the service provided by the ram breeders. Although the direct users of Sheeplan are ram breeders and charges should be made against them, the ultimate users are commercial sheep farms whose indirect demand for the service of Sheeplan drives the ram breeders' demand for Sheeplan. It is those benefits to commercial sheep farmers on which this study is focused.

This analysis considers the farm-gate market as the final goods market. Thus, the value added in the processing and retail markets are excluded.

ECONOMIC FRAMEWORK

A number of researchers (e.g. Blyth, 1983a; Laing and Zwart, 1983; Shaw, 1986) have modelled the complex and dynamic system of the New Zealand sheepmeat and wool industries. This study simplifies the system by collapsing it into a system of three product markets, lamb, mutton and wool. Each market is described by a demand and a supply function, with quantities demanded and supplied and own price as the variables. The respective demand and supply elasticities and a shift parameter describe each market.

The supply response of product i in year t can be expressed as:

$$Q_{it} = b_{it}(K_{it}, s_{it}) (P_{i,t-1})^e, \quad (1)$$

$i = \text{lamb, mutton, wool,}$

where Q_{it} : the supply quantity of product i in year t ,
 $P_{i,t-1}$: the price of product i in year $t-1$,
 e : the supply elasticity of product i ,
 s_{it} : the supply shift of product i in year t due to Sheeplan,
 b_{it} : the aggregated supply shift of product i in year t due to Sheeplan and all other variables, collectively denoted as K_{it} .

Equation (1) can be rewritten as

$$Q_{it} = (1+s_{it}) b'_{it}(P_{i,t-1})^e, \quad (2)$$

where b'_{it} is the aggregated supply shift of product in year t due to K_{it} (excluding the effect of Sheeplan). Therefore, the net effect of Sheeplan on supply can be separated from the total supply. The outward supply shift due to Sheeplan is attributable to two sources, genetic improvement (g_t) and change in Sheeplan membership (m_t).

$$s_t = g_t * m_t \quad (3)$$

The supplies of lamb, mutton and wool are assumed to depend on the previous year's prices. In Figure 1, S and S' are the supply with and without Sheeplan, respectively; D is the demand and S' is shifted to S by the factor of s_t as a result of Sheeplan, where s_t is the percentage shift in the supply curve $\frac{OA - OE}{OE}$.

The supply function without Sheeplan, S' , is (dropping the product index, for simplicity).

$$Q_t = b'_t P_{t-1}^e, \quad (4)$$

and the supply function with Sheeplan, S , is

$$Q_t = b_t P_{t-1}^e \text{ where } b_t = b'_t(1+s_t). \quad (5)$$

The demand function, D , is

$$P_t = aQ_t^{-n}, \quad (6)$$

and the demand elasticity, ξ , is equal to $1/n$.

The change in producer surplus (ΔPS) for each year is

$$PS = \left[A \cdot P_2 - \int_0^A (S) d(Q) \right] - \left[E \cdot P_3 - \int_0^E (S') d(Q) \right] \quad (7)$$

$$= (OABP_2 - OAH) - (OEFP_3 - OEG).$$

The change in consumer surplus (ΔCS) for each year is

$$CS = \left[\int_0^A (D) d(Q) - A \cdot P_2 \right] - \left[\int_0^E (D) d(Q) - P_3 E \right] \quad (8)$$

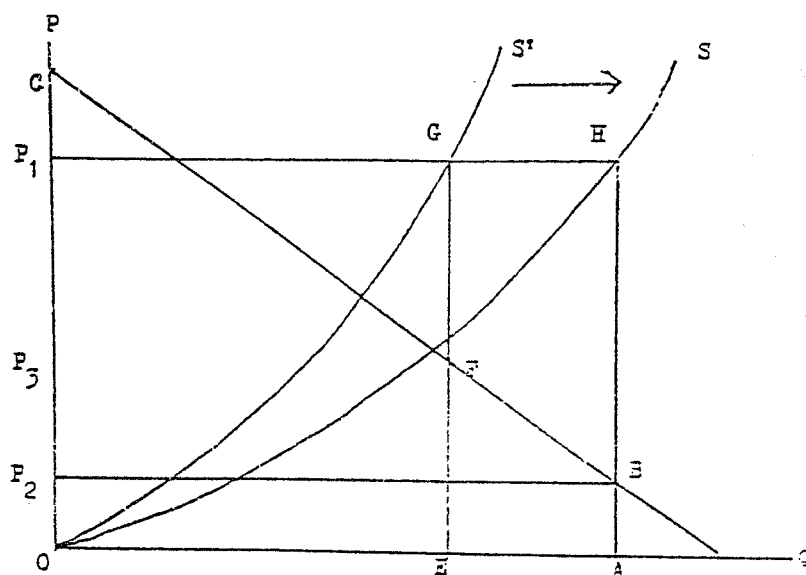
$$= P_2 BC - P_3 FC = P_2 BFP_3.$$

The net change of social benefit for each year (ΔSB) is the sum of ΔPS and ΔCS ,

$$\Delta SB = \Delta PS + \Delta CS$$

$$= \int_0^A (D) d(Q) - \int_0^E (D) d(Q) - \int_0^A (S) d(Q) + \int_0^E (S') d(Q). \quad (9)$$

Figure 1 Supply Shift Resulting from Sheepplan



NATURE OF GENETIC IMPROVEMENT

The heritability of genetic gains and the assumption of a constant rate of genetic improvement results in high returns to many genetic research findings. The first gain to a Sheeplan breeder is assumed to be realised one generation after joining Sheeplan. The generation interval is assumed to be 3 years. The ram breeder can retain the genetic gain for several generations even if he ceases to subscribe after only one year in the scheme. For the same reason a commercial farmer can retain the genetic gain for several generations even if he only purchases Sheeplan recorded rams once.

At any time t , the genetic gain (g_t) is the average of that of the ram (g_r) and that of the ewe (g_e). It also reflects the cumulative sum of the incremental gain in past years and the gain in the current year, as shown in Figure 2. The former is called incremental gain (g_i) and the latter is called cumulative gain (g_c). If the breeder remains in the scheme, the cumulative gain will accumulate over time while the incremental gain remains constant. Note that the incremental gain is actually the result of the sire's genetic gain obtained one generation ago. The key is that breeders and farmers will always have positive cumulative gains while the incremental gain disappears if quitting the scheme. If the gain is not heritable, however, the cumulative gain will also disappear.

Algebraically, the gain in year t can be expressed as:

$$g_t = (g_{r_t} + g_{e_t})/2, \text{ for } t > 3 \quad (10)$$

$$= 0, \text{ otherwise;}$$

where

$$g_{r_t} = (t-3)g_{s_i} \quad (11)$$

$$g_{e_t} = g_{t-1} = (g_{r_{t-1}} + g_{e_{t-1}})/2 \quad (12)$$

and g_{s_i} is the expected annual rate of production increase of which the derivation will be discussed in detail in the following section.

Substitute (11) and (12) into (10) ,

$$g_t = 0.5[(t-3)g_{s_i} + 0.5(g_{r_{t-1}} + g_{e_{t-1}})], \quad (13)$$

and after repetitive substitutions, we have

$$g_t = \sum_{i=1}^t (1/2)^i g_{r_{t+1-i}} \quad (14)$$

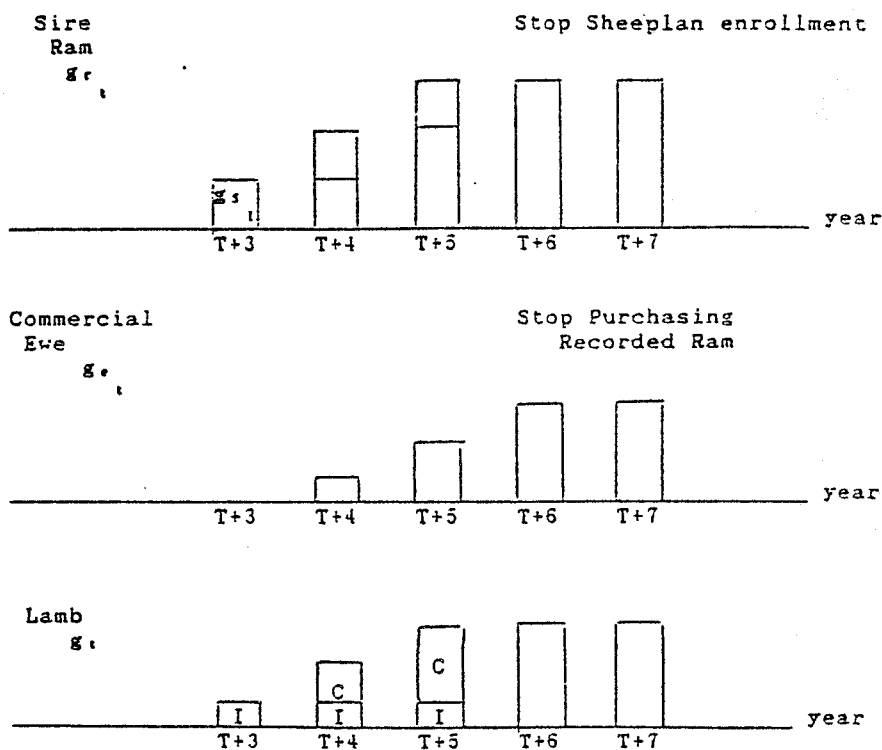
$$= \sum_{i=1}^t (1/2)^i (t-2-i)g_s \quad (15)$$

And (3) can be rewritten as

$$s_t = \sum_{i=1}^t (1/2)^i (t-2-i)g_s * m_t, \quad \text{for } t > 3 \quad (16)$$

$= 0, \text{ otherwise.}$

Figure 2 Nature of Genetic Gain



Alternatively, g_t can be expressed as the sum of the incremental gain (g_i) and the cumulative gains (g_c):

$$g_t = g_i + g_c, \quad (17)$$

where $g_i = g_i = 0.5g_s$ (18)

The cumulative gain (g_c) is simply the difference between (15) and (18).

PARAMETER USED

Genetic parameters

Bywater (1986) assumed that ram breeders are 70% effective in using the recorded information and derived the genetic gain per generation parameters with index selection under Sheeplan for Number of lamb born (NLB), Weaning Weight (Wwt) and Fleece Weight (Fwt). The reason that breeders are not 100% effective in using the recorded information is because they normally select rams based on not only the recorded information but also other physical traits as well.

Callow (1986) assumed the effectiveness in using recorded information under the current Sheeplan scheme is 50%, and computed the benefits of the proposed redevelopment based on the assumption that it will increase genetic gains by 40% as a result of more accurate selection decisions and by another 30% as a result of improved effectiveness in using Sheeplan records. Table 1 shows the expected gain per generation per ewe under NFRS (S_T), current Sheeplan (S_I) and its redevelopment, assuming 50 percent and 70 percent effectiveness in using Sheeplan record at present.

Table 1: Expected Genetic Gain per Generation per Ewe

Plan	Number of Lamb Born (no)	Weaning Weight (kg)	Fleece Weight (kg)
S_T NFRS	.0138	----	.0506
S_I current Sheeplan	.0314	.4133	.0255
50% effectiveness			
S_I redevelopment	.0571	.7522	.0464
S_I current Sheeplan	.0440	.5786	.0357
70% effectiveness			
S_I redevelopment	.0800	1.0530	.0650

Source: Bywater (1986) and Callow (1986).

The above parameters were used to compute the expected annual rate of incremental increase of sheepmeat and wool production. The expected annual rate of incremental increase of sheepmeat under Sheeplan is derived by multiplying the difference between S_I and S_T of Wwt by the NLB gain and then dividing by the average carcass weight (AVW) and by the generation interval (GI). The expected annual rate of incremental increase of wool production under Sheeplan is computed in the same way. The average carcass weight of lamb is assumed to be 13.34kg and the average wool production is assumed to be 5.37kg per head per year.

$$g_s \text{ (sheepmeat)} = \frac{[Wwt(S_I) - Wwt(S_T)] * NLB}{AVW * GI} \quad (19)$$

The production and price data needed to estimate the benefits associated with the current Sheeplan are mostly readily available. On the other hand, to measure the benefits associated with the redevelopment of Sheeplan, requires forecasting production of sheepmeat and wool, and

their prices, up to the turn of the century. Given the volatility of the sheepmeat and wool markets such a forecasting exercise would have very high errors, even if it were possible. Alternatively, the issue can be addressed by asking what would be the benefits and costs if the redevelopment had been implemented in 1976, while assuming that the production of sheepmeat and wool and their respective prices remain the same as under Sheeplan. The expected annual rates of incremental increase of sheepmeat and wool production under redevelopment have been computed on this basis.

Table 2: Expected Annual Rate of Production Increase (g_s)

Plan	Sheepmeat (% / per year)	Wool
Current Sheplan 50% effectiveness Redevelopment	1.040 1.906	-0.15670 -0.02639
Current Sheeplan 70% effectiveness Redevelopment	1.460 2.689	-0.09350 0.09136

Sheeplan Membership

The proportion of sire producing ewes recorded under NFRS increased on average 1.25% annually between 1967 and 1975, although total enrollment showed signs of levelling off in 1974 and 1975 (Bywater, 1986). The proportion of sire producing ewes recorded under Sheeplan increased on average 1.54% annually between 1976 and 1985, although again, total enrollment slowed down in 1984 and 1985 (Bywater, 1986). It is assumed in this study that the increase of enrollment rate between 1976 and 1984 was due to the introduction of Sheeplan in 1976. Therefore the membership of Sheeplan at time t (m_t) can be expressed as:

$$m_t = .125 + .0154t. \quad (20)$$

Since genetic gain accrues three years after joining the scheme, equations (16) and (3) can be rewritten as:

$$s_t = \sum_{i=1}^t (1/2)^i (t-2-i)g_s * [(.125 + .0154(t-2-i))] \quad (21)$$

Finally, (21) can be substituted into (2) to derive the supply at any year t as a function of the following parameters: shift effect excluding Sheeplan (b'_{it}), production elasticity (e), incremental genetic gain due to Sheeplan (g_s) and time (t).

Economic Parameters

Laing and Zwart (1983) and Shaw (1986) estimated the supply responses of lamb, mutton and wool production. In general, the estimated supply elasticities are all relatively low, ranging from 0 to 0.20 (ignoring negative estimates). Several trials based on different elasticity values were performed to test the sensitivity of the estimates of the consumer and producer gains. As there were only insignificant differences, one set of supply elasticities was chosen for further analysis: 0.20 for lamb, 0.11 for mutton and 0.08 for wool.

Blyth (1983b) estimated the export demand elasticity for New Zealand sheepmeat as being -9.50 (high), -6.5 (medium) and -3.5 (low). This study assumes identical demand elasticity for lamb, mutton and wool. All three values will be used to estimate the benefits associated with the scheme.

Since the demand is much more elastic than supply for all three products the producer surplus gain will be larger than the consumer surplus gain, justifying the need for a user pays system.

The time span of the study covers the period from 1976 to 1991. Data on production and prices from 1976 to 1986 are taken from various issues of New Zealand Agricultural Statistics (MAF) and Annual Review of the Sheep and Beef Industry (NZMWB'ES). All three products showed common trends during the period of a significant increase of production and a drop in real prices. The forecasted sheep numbers and lamb and mutton slaughter numbers from 1987 to 1991 are from "Likely Trends of Sheep and Beef Cattle Numbers, 1986-1991" (NZMWB'ES, 1986).

Three sets of prices for lamb, mutton and wool for 1987 to 1991 are used:

- (1) extrapolations of the linear trend, (trend);
- (2) means of prices between 1976 and 1986, (optimistic); and
- (3) the 1986 levels, (pessimistic).

All prices and costs are computed at the March quarter 1986 prices.

Additional on-farm recording costs under Sheeplan and its redevelopment are assumed to be \$1.92 per ewe. (based on Bywater, 1986). The number of recorded ewes was 203,415 in 1976.

COST AND BENEFIT ANALYSIS

Costs

No estimate of costs pertaining to the research and development of the current Sheeplan is available. Therefore the internal rate of return (IRR) and the net present value (NPV) are computed only for the redevelopment.

The capital costs of the research and development of the redevelopment of Sheeplan are assumed to be \$636,000. The extension costs for the promotion and extension and advisory service are assumed to be \$450,000 per annum for three years during the planning period.

Table 3: Costs Summary of Sheeplan Redevelopment (\$)

R&D		
Capital		635,000
R&D		750,000
Extension		600,000
OPERATION		
PER ANNUM		
Processing	475,000	
Ext and R&D	72,000	
Maintenance	119,000	
Subtotal		666,000

source: Callow and Clarke (1986) and
Lysaght (personal communication)

After the implementation, the annual operating costs are assumed to be \$666,000, of which \$475,000 is processing costs, \$72,000 is the on-going extension and R&D costs and \$119,000 is technical maintenance costs. The net present value of total costs of the proposed scheme is \$5.7 million.

Benefits

The changes in consumer and producer surpluses for lamb, mutton and wool markets were estimated for both the current Sheeplan, and the scenario that redevelopment had been introduced in 1976. The New Zealand consumer surplus gain is assumed to share 10% of the total consumer surplus gain, because only 10% of the sheepmeat and wool are consumed domestically.

This section concentrates on the "average" case in which parameters are set at the following values:

- (1) output prices -- "trend" prices;
- (2) export demand elasticities -- medium (-6.5 for all);
- (3) supply elasticities -- 0.20 for lamb, 0.11 for mutton and 0.08 for wool;
- (4) effectiveness in using records -- 50%; and
- (5) annual rate of membership increase -- 1.54%.

The costs were subtracted from the annual benefits to compute the IRR and NPV (using a discount rate 10%). Table 4 shows the benefits of Sheeplan and its redevelopment for the "average" case.

The first benefit of the scheme accrues three years after the introduction of Sheeplan. Afterwards benefits grow until 1986, when the prices of lamb and mutton were expected to drop by 40% (Table A.1). The net present value of change in producer surplus due to Sheeplan redevelopment (\$13.7 million) would be more than double that of the current scheme (\$5.9 million). The producer surplus gain outweighs the consumer surplus gain by more than 26 to one, suggesting the user pays system is justifiable. The average gross benefits before paying the user fees are \$1.50 per Sheeplan recorded ewe and \$3.48 under the redevelopment. After fully recovering the development and operating costs, the new scheme still generate a net return of \$1.70 per recorded ewe. The internal rate of return to the Sheeplan redevelopment is 27%.

Table 4: Return to Sheeplan and the Proposed
Redevelopment ("Average" Case)

Benefits	Current	Proposed
Net Present Value of Change in Producer Surplus (\$m)	5.9	13.7
Net Present Value of Change in Consumer Surplus (\$m)	0.2	0.3
Net Present Value of Change in Total Surplus (\$m)	6.1	14.0
Gross Benefits / per Recorded ewe (\$)	1.50	3.48
Net Present Value of Return (\$m)	N/A	7.0
Return /per Recorded ewe (\$)	N/A	1.70
Internal Rate of Return (%)	N/A	27

Incremental vs Cumulative Benefits

High NPV's of the change in producer surplus show that the sheep industry as a whole benefits from Sheeplan and its redevelopment. The average benefit per recorded ewe (\$1.50) is higher than the proposed 1986-87 levy level (\$1.30 per ewe). But in 1986 a number of breeders have dropped out of Sheeplan. After examining the two components of the total producer surplus change (Table A.2), it is evident that the high producer surplus gain is primarily due to the cumulative gain. The cumulative gain significantly outweighs the incremental gain in every year. In 1986 the incremental producer surplus gain of joining Sheeplan is negative (-\$306,000) while the \$491,000 cumulative producer surplus gain can be obtained without joining Sheeplan, although joining will assure a higher cumulative gain in future years.

Many factors affect a breeder's decision about whether to continue subscribing to the Sheeplan service. Their current cash flows may play an important role in deciding whether to continue. Some breeders evaluate the benefits of joining Sheeplan only by the incremental gain and do not necessarily consider the future gain. As a result, some have dropped out of Sheeplan during a year of reduced cash flows.

SENSITIVITY ANALYSIS

A series of sensitivity analysis were performed with respect to the uncertain parameters:

- (1) output prices,
 - (2) demand elasticities, and
 - (3) effectiveness in using Sheeplan records;
- and with respect to the membership parameter.

Only one parameter at a time was changed from the "average" case (see pages 14-15) in order to isolate the effect of each change. Results are summarised below:

- (1) Output Prices: The differences between the "average" and the pessimistic cases are less significant than that between the optimistic

and the "average" cases. Since the "average" case assumes that prices continue to decline, the estimated benefits are likely to be understated if prices discontinue their downward trend.

(2) Demand Elasticities: Higher demand elasticity corresponds to higher benefits. Since the export demand elasticity facing a small open economy is relatively high, the estimated benefits are expected to be closer to those found using an elasticity of -9.5.

(3): Effectiveness in using Records: Improving effectiveness in using Sheeplan records and increasing Sheeplan enrollment have great potential to increase the return to the current scheme.

Table 5, summarising the above results, provides the lower and the upper bounds of the estimated benefits.

Table 5: Upper and Lower Bounds of the Estimated Benefits

Benefits	Current		Proposed	
	Lower	Upper	Lower	Upper
NPV of PS (\$m)	4.0	12.6	11.1	19.9
NPV of CS (\$m)	0.4	0.4	0.6	0.5
NPV of SB (\$m)	4.4	13.0	11.7	20.4
Gross Benefit /per Recorded Ewe (\$)	1.01	3.22	2.82	4.29
NPV of Return (\$m)	N/A	N/A	4.7	13.4
Return/ per Recorded Ewe (\$)	N/A	N/A	1.05	2.79
IRR (%)	N/A	N/A	21	35

USER PAYS CONSIDERATION

This study does not identify the economic benefits to ram breeders because of time and data constraints. Instead, the major goal of this study is to estimate the benefits to commercial sheep farmers, which can be used to approximate the upper limit of the charge that users of the scheme would be prepared to bear. The reason for this is that if commercial sheep farmers are not willing to pay for the service provided by ram breeders, ram breeders will not be able to pay a penny for the Sheeplan service.

Benefits to ram breeders can be used to approximate the upper limit the Sheeplan Council can charge ram breeders. Similarly, benefits to commercial sheep farmers can be used to approximate the upper limit ram breeders can charge commercial sheep farmers for the service. Realised charges become ram breeders' profit. Therefore, benefits to commercial sheep farmers can also be used to approximate the upper limit ram breeders are willing to pay for the Sheeplan service.

The results of the analysis from the previous sections indicate that the Sheeplan redevelopment is financially justifiable, since total before charge economic benefits to commercial sheep farmers (between \$11.1 and \$19.9 million) exceeds the costs of Sheeplan redevelopment (\$5.7 million). Thus, a user pays scheme to recover the Sheeplan redevelopment costs is feasible.

Before charge benefits to sheep farmers are estimated to be between \$2.82 and \$4.29 per recorded ewe, which approximate the upper limit farmers are willing to pay to the breeders. In turn, this figure also approximate the upper limit the breeders can charge the sheep farmers and, thus, are willing to pay for the Sheeplan service. However, if total benefits are broken down to the immediate incremental gains and the future cumulative gains the former is smaller than the latter and may even be negative. In fact in 1986 the incremental benefits to producers are less than the user charge (possibly negative); therefore some ram breeders with cash flow problems are dropping out of Sheeplan.

Clearly, if the Sheeplan Council were to charge this upper limit amount to ram breeders, ram breeders, then, would charge the same amount to commercial farmers, leaving no benefits to breeders or sheep farmers. On the other extreme, if the Sheeplan service were to be free of charge to breeders, it would be up to these breeders to decide how much they would charge commercial sheep farmers for using their service. Under this circumstance, the breeder's charge to sheep farmers could range, theoretically, from none to the upper limit. The exact charge would be determined by demand and supply in the breeder's service market. Regardless what amount breeders would charge sheep farmers, both would stand no worse off than had there been no Sheeplan service.

The finding indicates that a user pays scheme to recover all the Sheeplan redevelopment costs is bearable to ram breeders and commercial sheep farmers if total long term benefits, not just the immediate incremental benefits, are considered by the breeders and farmers. The cost of Sheeplan redevelopment is estimated to be between \$1.50 and \$1.80 per ewe. After paying the full costs, the industry is still left with net benefits between \$5.4 to \$14.2 million or between \$1.05 to \$2.79 per recorded ewe. This study made no attempt to examine the distribution of these net benefits between ram breeders and commercial sheep farmers.

REFERENCES

- Annual Review of the Sheep and Beef Industry. New Zealand Meat and Wool Boards' Economic Service. various issues.
- Bell, R. (1985). Sheeplan Feasibility Study. Azimuth System Limited, Wellington.
- Blyth, N. (1983a) The World Sheepmeat Market: an econometric Model. Research Report No. 138, AERU, Lincoln College.
- (1983b) A Note on: The Elasticity of Demand for New Zealand Sheepmeat Exports. AERU, Lincoln College.
- Bywater, T. (1986). An Assessment of the Value of the Long Term Studies on Sheep and Cattle Breeding at Waikite, Economics Div., MAF. Technical. Report 4/86.
- Callow, C. (1986). Return on Investment - basis of dollars in NZSAP paper-. mimeo. Hamilton.
- Callow, C. and Clarke, J.N. (1986). Financing Sheeplan by User Pay, mimeo. Hamilton.
- Clarke, J.N. and Rae, A.L. (1977) Technical Aspects of the National Sheep Recording Scheme (Sheeplan). Proceedings of the New Zealand Society of Animal Production, (37):183-197.
- Dodd, C.J. and Delahunty, J.R. (1983). Selection Efficiency in Ram Breeding Flocks. Proceedings of the New Zealand Society of Animal Production, (43):193-196.
- Laing, M.T. and Zwart, A.C. (1983). Investment and Supply Response in the New Zealand Pastoral Sector: An Econometric Model. Research Report No. 137, AERU, Lincoln College.
- Lysaght, P.A. (1986) Sheeplan - Where To From Here. Manuscript, MAF.
- Monthly Abstract of Statistics March 1986. (1986). Dept. of Statistics.
- New Zealand Agricultural Statistics. MAF. various issues.
- NZMWB's Economic Service. (1986) Likely Trends in Sheep and Beef Cattle Numbers 1984-85 to 1990-91. Paper No. G1934.
- Norton, G.W. and Davis, J.S. (1981). Evaluating Returns to Agricultural Research: A Review. Amer. J. Agr. Econ., (63):685-699.
- Scobie, G.M. and R. Posada T. (1977). The Impact of High-Yield Rice Varieties in Latin America with special emphasis on Colombia. CIAT.
- Shaw, I. (1986) Modelling New Zealand Wool and Sheep meat Supply: An Alternative Approach. presented at the 30th Annual Conference of the Australian Agr. Econ. Society, Canberra.
- Wood-Belton, M. and Lattimore, R.G.J. (1985). Supply Response Parameters in New Zealand Agriculture - a Literature Search. Discussion Paper No. 96, AERU, Lincoln College.

Table A.1: Benefits of Sheeplan and Its Redevelopment (\$'000)*

	Current			Proposed			Difference		
	ΔPS	ΔCS	ΔSB	ΔPS	ΔCS	ΔSB	ΔPS	ΔCS	ΔSB
76	-399	0	-399	-399	0	-399	0	0	0
77	-409	0	-409	-409	0	-409	0	0	0
78	-418	0	-418	-418	0	-418	0	0	0
79	40	10	51	718	25	744	678	14	692
80	697	27	725	2497	66	2564	1799	39	1839
81	1160	38	1198	3483	90	3573	2323	51	2375
82	1781	50	1832	4925	117	5043	3144	67	3211
83	1952	57	2010	5233	131	5364	3280	73	3354
84	2361	64	2426	6035	145	6180	3673	80	3753
85	2645	72	2717	6793	163	6956	4148	91	4239
86	184	27	212	2028	76	2105	1844	48	1893
87	1973	52	2025	5365	122	5487	3392	69	3462
88	1503	48	1551	4479	114	4594	2976	66	3042
89	1313	44	1358	4097	106	4204	2784	62	2846
90	1062	39	1101	3622	96	3718	2559	57	2616
91	906	35	942	3307	89	3397	2401	53	2454

* the "average" case

 ΔPS : consumer surplus, see equation (8) ΔCS : producer surplus, see equation (7) ΔSB : social benefits = $\Delta PS + \Delta CS$ Table A.2: Decomposition of Producer Surplus Gain:
Incremental Gain and Cumulative Gain (\$'000)

	Producer Surplus Change								
	Current			Proposed			Difference		
	Inc.	Cum.	Total	Inc.	Cum.	Total	Inc.	Cum.	Total
76	-399	0	-399	-399	0	-399	0	0	0
77	-409	0	-409	-409	0	-409	0	0	0
78	-418	0	-418	-418	0	-418	0	0	0
79	40	0	40	718	0	718	678	0	678
80	41	656	697	802	1695	2497	760	1039	1799
81	87	1072	1160	860	2622	3483	773	1549	2323
82	218	1562	1781	1168	3757	4925	949	2194	3144
83	230	1721	1952	1177	4055	5233	947	2333	3280
84	323	2038	2361	1358	4676	6035	1035	2637	3673
85	384	2261	2645	1538	5254	6793	1154	2993	4148
86	-306	491	184	200	1828	2028	507	1336	1844
87	173	1799	1973	1103	4261	5365	930	2462	3392
88	35	1467	1503	847	3631	4479	811	2164	2976
89	-24	1338	1313	732	3365	4097	756	2027	2784
90	-100	1163	1062	592	3030	3622	693	1866	2559
91	-151	1057	906	497	2810	3307	648	1752	2401

Inc.: incremental benefits

Cum.: cumulative benefits

Total: ΔPS from Table A.1

RISK BALANCING: A PRELIMINARY EMPIRICAL ANALYSIS
FOR THE NEW ZEALAND SHEEP AND BEEF SECTOR

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ABSTRACT

Risk is an integral part of the decision making process and has received considerable exposure in the literature. A hypothesis tested with some success in the United States suggests that apart from the general business risk (market, climate etc) involved in the initial investment and subsequent production response, there is an additional element to risk that originates from the financing decision.

The risk balancing hypothesis suggests that business risk and financial risk could possibly be trade-offs in overall risk behaviour. Preliminary investigation offers some support for the hypothesis on New Zealand sheep and beef farms, particularly over the period 1959-72. Increasing levels of Government assistance over the latter period of the analysis, 1973-85, suggest a change in total risk bearing behaviour.

Key Words: Business Risk, Financial Risk, Risk Balancing, Regression Analysis, Sheep and Beef Farms.

Introduction

Risk is an inherent element of the commercial decision making process. Agriculture, while being subject to the general vagaries of the market place is also subject to a range of additional risks that influence the biological system, such as climate, disease and pests.

A wide range of public and private mechanisms have evolved in many countries to reduce the risk faced by agricultural producers.

Rostamizadeh (1985) gives a good summary of the strategies available for risk management in New Zealand agriculture. For example statutory stabilization schemes (in particular wool, meat and dairy) were designed to minimise the impact of fluctuating product

prices on farm incomes.¹ However through the middle 1970's to 1985, increasing amounts of public funds were injected into the sector, as price stabilization was increasingly supplemented by income support (SMPs and input subsidies). The taxpayer accordingly assumed an increasing share of the market risk facing agricultural producers in New Zealand.

The current Government's drive for economic efficiency necessitates that resource allocation be dictated by true market signals. Accordingly, the movement towards non-intervention has seen the effective rates of assistance for agriculture declining from a high of 314% in 1984 to an estimated - 1% in 1987. (Situation and Outlook for New Zealand Agriculture, (1987) pp. 9-11.)

The responsibility for risk management now lies with the individual or the sector upon which the collective benefits are conferred.

A better understanding of the impact of risk in the decision making process of sheep and beef farmers, and the evolution of management mechanisms, both private and collective, will be of increasing interest to policy analysts².

Objectives of the Study

To test for the New Zealand sheep and beef sector, the risk balancing hypothesis developed by Gabriel and Baker (1980) and applied with some success to the aggregate United States agricultural sector.

1 See Zanetti et al (1975) for a review and background to stabilization policies enacted at that time.

2 As far as the authors are aware, the only New Zealand quantitative study of agricultural investment that includes a risk variable is that of Laing (1982) who used the variance of price as a measure. Risk has however been recognised by our practitioners of cost-benefit analysis, for example, Shepherd (1970), and Bell (1977).

Concepts

Risk and uncertainty while often used synonymously, are theoretically distinguished (Knight, 1921) such that in cases where probabilities can be assigned to outcomes then the conditions are referred to as risk. When this cannot be achieved the situation is referred to as uncertainty.

At a theoretical level, the incorporation of risk parameters into a profit maximisation framework produces first order conditions where the marginal factor cost (input price) is equal to the value of the marginal expected product less a marginal risk deduction that depends on the utility function and the marginal variance of revenue. (Anderson, Dillon, and Hardaker (1977), pp.161-169.)

In decision making analysis, models incorporating a risk component have greater "predictive" power. Lin, Dean and Moore (1974), found that an expected utility specification outperformed profit maximisation models.

Risk, as it is defined in studies such as those referred to above, would in the context of this study be defined as business risk.

(a) Business Risk

Business risk is defined as the risk inherent in the firm independent of the way it is financed (Gabriel & Baker(1980) p. 560). It is generally reflected by the variability of net operating surplus and accordingly an appropriate measure of relative dispersion is the coefficient of variation (standard deviation divided by the mean).

(b) Financial Risk

Financial risk is defined to be the added variability of net cashflows of the owners of equity that results from fixed debt servicing charges. With increasing levels of debt, the possibility of cash insolvency and business failure also increases.

To illustrate these concepts, the following example, taken from Van Horne (1983, pp. 358-359) is presented.

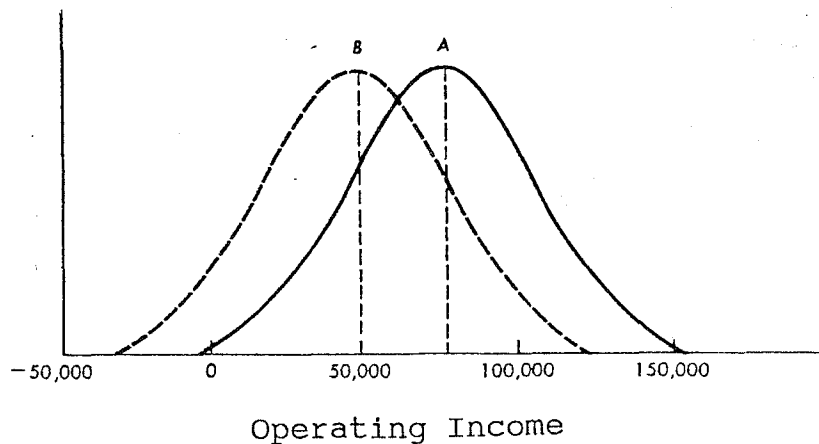
Consider two firms, A and B who are identical in every respect except that B has borrowed \$300,000 at 10 percent interest. Operating incomes are assumed to be subjective random variables with a mean of \$80,000 and standard deviation of \$40,000.

Both firms are exposed to the same degree of business risk, with a coefficient of variation of 0.50 ($40,000/80,000$). However, because firm B has an interest commitment of \$30,000 its expected earnings before tax are \$50,000, accordingly the relative dispersion is 0.50 for firm A, and 0.8 for firm B. Because firm A has no external financing it has by definition no financial risk, while firm B has a financial risk factor of 0.3, $(0.8 - 0.5)$.

Graphically the case is shown in Figure I, where the degree of dispersion is equivalent for both firms, but the expected value of earnings for A is greater than B.

Figure 1: Probability Distribution of Expected Operating Income

Probability



Risk Balancing

It is now appropriate to develop an algebraic representation of the concepts covered so far.

Let:

σ_1 = standard deviation of net cash flows in the absence of debt financing.

σ_2 = standard deviation of net cash flows with debt financing.

\overline{CX} = expected net cash flows in the absence of borrowing.

I = debt servicing commitments.

Business risk (BR), can then be expressed as:

$$BR = \frac{\sigma_1}{\overline{CX}} \quad - (1)$$

Financial risk (FR), being the incremental risk due to capital borrowings, is thus defined as:

$$FR = \frac{\sigma_2}{\overline{CX} - I} - \frac{\sigma_1}{\overline{CX}} \quad - (2)$$

which can be re-expressed as:

$$FR = \frac{\sigma_2 - \sigma_1}{(\overline{CX} - I)} + \frac{\sigma_1}{\overline{CX}} \cdot \frac{(I)}{(\overline{CX} - I)} \quad - (3)$$

Risk balancing is in the words of Gabriel and Baker (pg 561):

"the adjustment in the components of total risk (ie business and financial risk) that results from an exogenous shock to the existing balance. This shock is to be represented by a change in business risk and viewed within the context of a total risk constraint".

To illustrate this, total risk (TR) is the summation of business risk and financial risk, ie:

$$TR = BR + FR \quad - (4)$$

A total risk constraint³ with an upper limit of β is defined, thus:

$$TR \leq \beta \quad -(5)$$

Consider the case where there is no leverage induced change in business risk (ie $\sigma_1 = \sigma_2$) then according to the definition,

$$TR = \frac{\sigma_1}{cx} + \frac{\sigma_1 \cdot I}{cx(cx-I)} \quad -(6)$$

Since the term for financial risk includes the business risk component (σ_1/cx) it is then directly influenced by it. If σ_1 increases and there is no slack in the risk constraint, financial risk will also rise thereby triggering a risk adjustment to comply with the constraint. This adjustment, as Gabriel and Baker note may involve a production or an investment or a financing decision, or all three.

This adjustment is what is referred to as risk balancing.

Model Specification

To test the risk balancing hypothesis in the New Zealand context, the ratio $I/(CX-I)$ in which the financial risk adjustment takes place, was regressed against a set of likely explanatory variables.

In the first instance, the model tested was:

$$I/(CX-I)_t = f(CV_{t-1}, it_{t-1}, \pi_{t-1}, P_{t-1}) \quad -(7)$$

where:

CV = 3 year moving coefficient of variation of net operating surplus (business risk)

3 In an expected utility context, the degree of risk the decision maker would be willing to take or avert, would be represented by the "degree of curvature" of the expected utility function. For example, see Layard & Walters (1978, pp. 360-362.)

i = average cost of debt $\left(= \frac{\text{total interest paid}}{\text{total debt}} \right)$

Π = profitability of assets $\left(= \frac{\text{profit before tax}}{\text{total farm capital}} \right)$

P = land price index.

Apart from business risk, the average cost of debt, profitability of assets and changes in land prices (as it effects equity and have borrowing potential) are all assumed to impact on the financial risk.

In terms of the basic risk balancing equation (6), one would expect a priori that business risk is inversely related to the financial risk component. That is, one would expect a negative coefficient on CV. Similarly, other things being equal, one would expect that a greater return on assets would produce high debt coverage and have lower financial risk, producing a negative coefficient on the explanatory variable. However if profit was declining over the period, the coefficient should be positive, indicating greater risk exposure.

The average cost of debt is expected to positively impact on financial risk.

One would also expect the land price variable to be related to any underlying trend. In this case rising land prices, other things being equal, should provide greater security, thereby reducing financial risk. One would therefore expect a negative coefficient on the land price variable.

All explanatory variables are lagged to reflect the impact of recent events on current expectations (adaptive expectations).

Data Sources

With the exception of land prices, all other series were taken from various issues of the New Zealand Meat and Wool Board's Economic Survey of Sheep and Beef farms. The Valuation Departments price index of freehold fattening farm units sold on the open market was taken as a indicator for all sheep and beef farm types.

Results of Analysis

Before presenting the regression estimates, an examination of the scatter diagram (Figure 2) of business risk verses financial risk is intuitively instructive. Over the period 1962 to 1973⁴ the points appear to lie around a negatively sloped line, giving support to the hypothesis. The next group of points (1974-1978) reflect years of marked fluctuation in returns and the introduction of production incentives (LDELS in 1978 and LSIS in 1976) which induced higher levels of investment. Part of this investment was financed from external sources, hence the increase in financial risk. The last period, 1979 to 1985, fully reflects the impact of SMPs, with a reduction in business risk (all points lying below 1974-1978) and a marked increase in financial risk.

The ordinary least squares (OLS) regression results are shown in Table 1. As was evident in the graphical analysis, the negative coefficient on the business risk variable (the coefficient of variation) supports the risk balancing hypothesis, namely, other things being equal, a fall in business risk leads to a rise in financial risk and vice versa.

Over the period of analysis, the average interest rate has been rising while profitability on assets has been declining. Both increased the financial risk faced by the sheep and beef sector, and accordingly the positive coefficients on these two variables reflect this.

The coefficient on the land price variable is negative, suggesting that rising land prices maintained high levels of equity, providing borrowing capacity, thereby reducing the financial risk (especially insolvency). The land price variable performed better than dummy variables for Government programmes (LDELS, LIS, SMPs). The benefits of these policies became capitalised into land prices, and the impact was more than the intercept change associated with the use of the dummy variables.

4 The dates alongside each observation relate to the dependent variable (financial risk).

Business Risk

Figure 1: Scatter Diagram of Business Risk verses Financial Risk, 1962-1985.

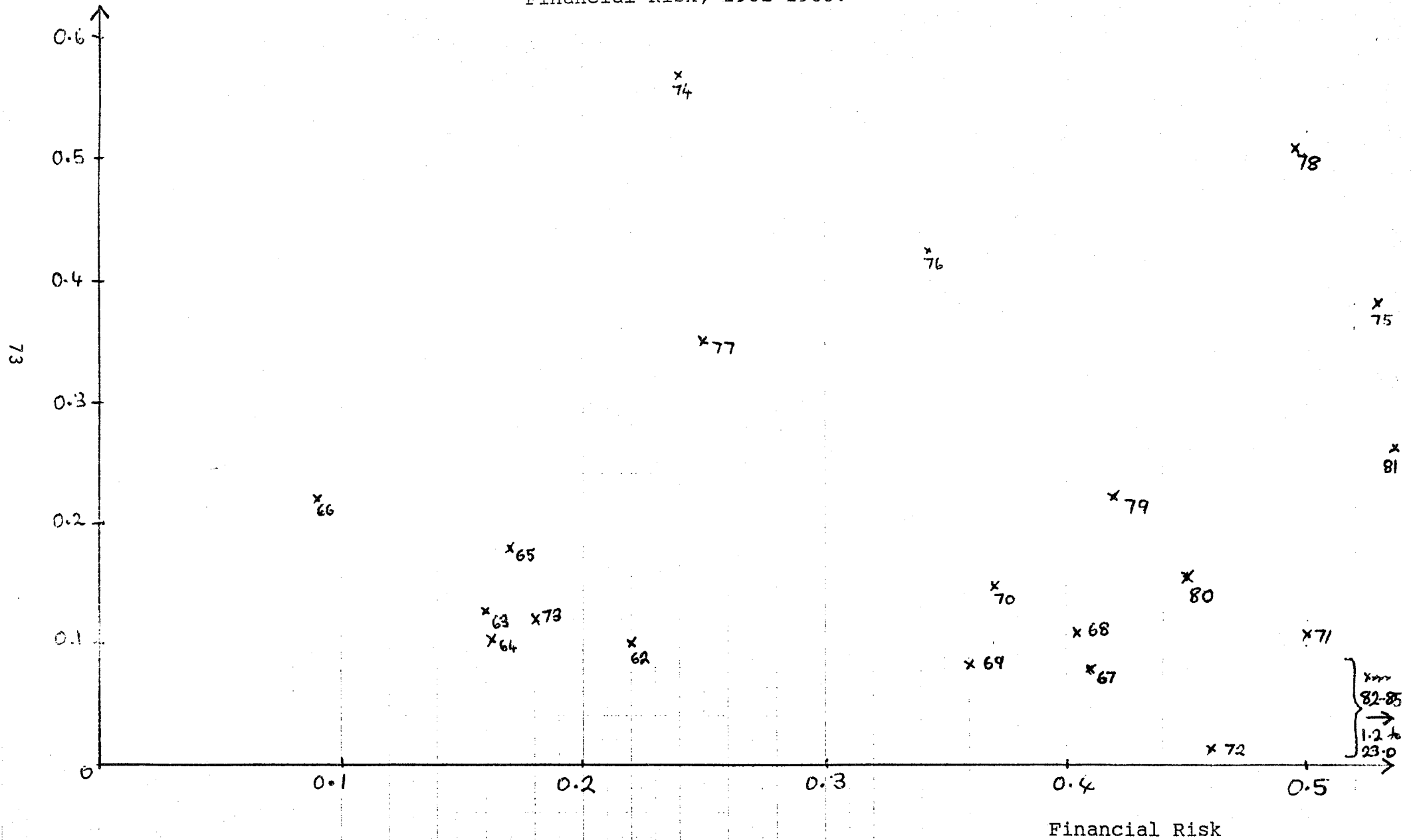


Table 1: Estimated Coefficients for Risk Balancing Model

Explanatory Variable	Coefficient	Standard Error
Constant	-35.512***	6.422
Business risk	-6.238*	3.397
Interest rate	6.733***	1.019
Asset return	0.962*	0.529
Land price	-0.015***	0.004

$R^2 = 79.48\%$ $F_{4,19} = 18.40***$
 $DW = 1.503$ $n = 24$
 * = significant at 10%
 *** = significant at 1%

Summary and Conclusions

The risk balancing hypothesis, as tested with success by Gabriel and Baker for the aggregate US agricultural sector, also appears to have some applicability for the New Zealand sheep and beef sector. The inverse relationship between business and financial risk is clearly illustrated up till 1973. For the later period of the analysis, the taxpayer, by carrying increasing levels of the business risk, has created an environment in which the level of financial risk has markedly increased. [Though not tested it is likely the overall risk factor has been substantially reduced.]

The implications from the empirical analysis are clear. Under the current Government's non-intervention policy regime, the degree of business risk has risen, along with the average interest rate, while land prices have significantly declined. As a result financial risk has risen to the level where the risk of cash insolvency becomes critical.

From a quantitative perspective, this concept of financial risk is currently the one with the greater pay-off for policy analysis. The analysis could be couched in terms of estimating the probability that the firm would not be able to produce a minimum (disaster) level of funds after having serviced debt⁵. This then is the problem of farm viability, and the quantification of factors influencing that viability.

The use of Monte Carlo balance sheet modelling (Leatham et al (1986), Perry et al (1985)), combined with an appropriate qualitative approach (Amemiya (1981)), such as a logit specification (Intrilligator (1978)) of survival functions is the next stage of this research project.

5 Let α = the probability, and Z = the disaster level of funds, then the relevant concept would be:
 $P(cx - I \leq Z) \leq \alpha$

REFERENCES

- Amemiya, T. (1981). Qualitative Response Models: A Survey. J.Econ.Lit., 19 : 1483-1536.
- Anderson, J.R., Dillion, J.L. and Hardaker, J. B. (1977). Agricultural Decision Analysis. Iowa University Press, Ames, Iowa.
- Bell, B.A. (1977). Analytical Risk Evaluation. Technical Paper 7/77, Economics Division, Ministry of Agriculture and Fisheries, Wellington, New Zealand.
- Gabriel, S.C. and Baker, C.B. (1980). Concepts of Business and Financial Risk. Amer J Agr. Econ., 62 : 560-564.
- Intrilligator, M.D. (1978). Econometric Models, Techniques and Applications, Prentice-Hall, Englewood Cliffs, New Jersey.
- Knight, F.H. (1921). Risk, Uncertainty and Profit. Houghton Mifflin Company, Boston.
- Laing, M.T. (1982). The New Zealand Pastoral Livestock Sector: An Econometric Model. AERU Research Report 127, Lincoln College.
- Layard, P.R.G. and Walters, A.A. (1978). Microeconomic Theory. McGraw-Hill, New York.
- Leatham, D.J., Perry, G.M., Rister, M.E. and Richardson, J.W. (1986). Farm Survival and Performance Under Alternative Financial Conditions and Credit Policies. Agribusiness, 2 : 321-337.
- Lin, W., Dean, G. and Moore, C. (1974). An Empirical Test Utility verses Profit Maximisation in Agricultural Production. Amer. J. Agr. Econ., 56 : 497-508.
- Ministry of Agriculture and Fisheries (1987). Situation and Outlook for New Zealand Agriculture, Wellington.
- Perry, G.M., Rister, M.E., Richardson, J.W. and Leatham, D.J. (1985). The Effects of Equity Position, Credit Policy and Capital Gains on Farm Survival. Agricultural Finance Review, 45 : 58-71.

Rostamizadeh, A. (1985). Strategies for Risk Management New Zealand Agriculture. Discussion Paper 3/85, Economics Division, Ministry of Agriculture, Wellington, New Zealand.

Shepherd, A.A. (1970). A Study of a Problem of Optimising the Allocation of Resources to Research : with Special Reference to Agricultural Research. Unpublished M.Agr.Sc thesis, Massey University.

Van Horne, J.C. (1983). Fundamentals of Financial Management. Prentice-Hall, New Jersey.

Zanetti, G.N. et al (1975). Report of the Farm Income Advisory Committee to the Minister of Agriculture and Fisheries. Government Printer, Wellington.

FUNDING AND CONDUCT OF AGRICULTURAL R&D IN NEW ZEALAND

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SUMMARY

The transaction cost approach indicates that market failure which results in underinvestment in R&D need not necessarily warrant government provision. The approach suggests that agricultural R&D may be efficiently funded by firms which can capture sufficient of the benefits to make the investment worthwhile. Where R&D results in spillovers, collectives of firms may together fund the R&D if they can together capture sufficient of the benefits to make the formation of a collective and the investment in R&D worthwhile. The government may have a role in facilitating the formation of collectives, in funding R&D which results in benefits which cannot be captured by firms or collectives, and in conducting R&D which cannot be efficiently bought from the private sector.

Key Words: Funding, Agriculture, R&D, Transaction Costs

INTRODUCTION

Recent government reductions in the public funding of research and development (R&D) and the introduction of the "user pays" principle to agricultural R&D in New Zealand have prompted several examinations of the state of science and technology (Beattie, 1986; O'Donnell and Troughton, 1986 and Ulyatt, 1986). This paper discusses the efficient funding and conduct of agricultural R&D in New Zealand which has historically been funded and conducted by the public sector, and has been concerned largely with production. Private sector R&D funded by firms and collectives such as Research Associations by levies on producers, has been concerned primarily with processing. The recent changes in public funding of agricultural R&D in New Zealand and changes in government macroeconomic policies are likely to lead to substantial changes in the traditional pattern of funding and undertaking of agricultural R&D.

An issue central to the discussion of agricultural R&D is that of the efficient use of available resources, which relates to the return on investment in agricultural R&D. A return higher than the the risk adjusted social opportunity cost of capital suggests that more resources should be invested. Conversely, a lower return would imply that resources should be moved out of agricultural R&D and into other, more profitable investments. Recent research indicates that investment in agricultural R&D in New Zealand has a large, long-term payoff, in keeping with estimates for other countries. Eveleens and

Scobie (1986) estimate the annual rate of return to agricultural R&D in New Zealand to be 30 percent over 23 years. This rate of return is generally higher than those observed in other public or private investments and suggests that there may be underinvestment in agricultural R&D in New Zealand.

The traditional "market failure" response to underinvestment has been government action to fund and conduct agricultural R&D. A new "transaction costs" approach suggests that underinvestment occurs when transaction costs, which accompany all economic activity, constrain or prevent exchanges of agricultural R&D. The underinvestment which results may be relieved by government policies to reduce transaction costs facing private investors in some instances. The government should reduce transaction costs only if they arise from impediments to activities which it is sensible for the government to reduce. If government actions are aimed at improving efficiency, they should be undertaken only when the benefits outweigh the costs. Government funding of agricultural R&D through levies or taxation will be efficient where private sector investment by firms or collectives is constrained and where other government actions are insufficient to bring about such investment.

"MARKET FAILURE" APPROACH TO R&D

The traditional "market failure" approach to R&D suggests that where a competitive economy does not invest in the "optimal" amount of R&D due to market failure, government intervention should be undertaken to improve the allocation of resources to R&D. The market failure justifications for public sector, taxation-based funding have dominated the literature since Arrow applied this approach to R&D (Arrow, 1962). This viewpoint continues to be important today, and emerges in the recent Beattie Report on Science and Technology in New Zealand (Beattie, 1986).

"However it is apparent that market forces alone will not lead to all the research and development required by a country being actually performed. Among the principal ways in which the market system can fail are

- i) where the cost of research and development is excessive in relation to the state of the industry (eg, infant industry or an industry as yet unborn);
- ii) where a firm cannot capture sufficient of the benefits of innovation for itself;
- iii) where the lead time necessary for the research and development exceeds the normal time scale considered by a firm when evaluating the return from an investment;
- iv) where the overall risk of failure in the project is perceived as excessive by sources of venture capital."

The principal theoretical drawbacks of the market failure approach to R&D are that it does not examine the underlying causes of market failure (which can be seen to originate in transaction costs), nor does it examine the efficiency of the government intervention it advocates. It thus provides an incomplete argument for public sector conduct and funding of agricultural R&D where there is

underinvestment.

"TRANSACTION COSTS" APPROACH TO R&D

A more recent approach to agricultural R&D is that of transaction costs, a relatively new development which is primarily associated with Williamson (See, for example, Williamson, 1985 and Baumol, 1986). It has become apparent that market failure arises because of the presence of transaction costs which occur with every exchange of goods and services, and which range in importance from the prohibitive to the trivial. These costs constrain and can even prevent exchanges of goods and services which would otherwise occur in frictionless markets without such costs. However, these are real costs associated with business activity, and must be faced by firms in the same way as costs of material, marketing, labour etc. Private investment in agricultural R&D will occur where the gains exceed the total costs of such investment. Where there are substantial transaction costs constraining private sector investment in agricultural R&D, the government may have a role in reducing these (e.g. removal of economic distortions, the formation of collectives) to facilitate further private investment where the benefits of doing so exceed the costs. Where the private sector faces transaction costs which prevent investment, and which cannot be economically reduced by government action, the government may have a role in funding agricultural R&D if the return is adequate. The transaction cost approach thus challenges the automatic response of the market failure approach that government provision is mandatory in the mere presence of market failure. It examines the sources of market failure and indicates where private and public sector funding of R&D may be efficient. It concludes that the public sector may have a reduced role in the funding and conduct of agricultural research, but may be more usefully engaged in formulating policies to reduce transaction costs facing private sector investors.

FUNDING N.Z. AGRICULTURAL R&D

Funding and Conduct of R&D

The funding of R&D can be separated from the conduct of R&D. Organizations which fund agricultural R&D may choose to carry out their research internally. Organizations which carry out their own R&D include private firms (e.g. in-house R&D), collectives of firms (e.g. WRONZ), or the public sector (e.g. DSIR). Alternatively, organizations which fund agricultural R&D may contract to buy R&D from independent organizations which carry out R&D in either the public or private sectors. Firms, collectives and private or public sector organizations may thus buy and sell R&D to other firms, collectives or private or public sector research organizations. Factors which are important in determining whether R&D will be internally undertaken and the type of contract involved in the sale of R&D are the frequency of transactions, the uncertainty surrounding the contract which is reflected in the costs of contracting to ensure adherence to the agreement, and the degree to which the assets of the seller are specific to a particular buyer (e.g. the assets of WRONZ

are likely to be specific to the interests of woolgrowers).

The Beneficiaries of Agricultural R&D

If the benefit conferred or "user pays" principle is accepted as an ethical norm, as it has become increasingly in New Zealand, equity requires that the beneficiaries should pay for agricultural R&D. The issues of efficiency and equity therefore coincide, both requiring the identification of the beneficiaries of agricultural R&D. The problems thus are ones of identifying the beneficiaries and establishing efficient mechanisms to link them with the funding of agricultural R&D.

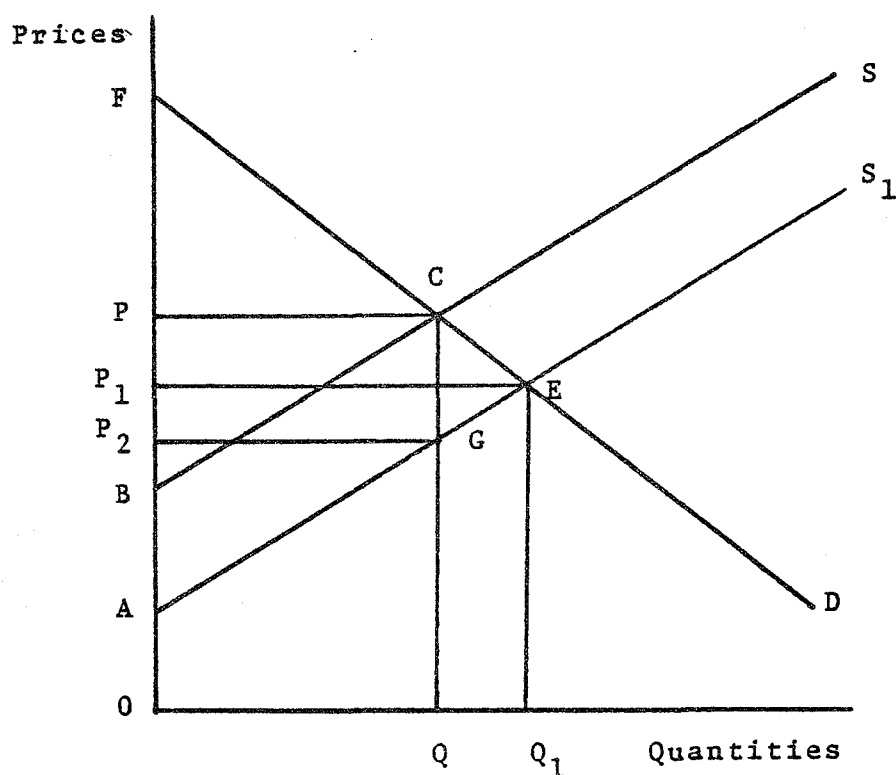
The objective of agricultural R&D is to increase productivity or to reduce costs through technological change which results in an aggregate economic surplus or national gain. The concept of economic surplus underlies methods to establish the direct benefits of applied agricultural R&D. The economic surplus generated by technological change in agriculture in New Zealand is broadly distributed among several different economic sectors: domestic and overseas consumers, measured by the consumers' surplus, and domestic and overseas producers and processors, measured by the producers' surplus.

The distribution of the benefits of agricultural R&D between producers and consumers can be shown diagrammatically in Figure 1. The demand curve is D and the supply curve S . The initial equilibrium is quantity Q , at price P . The initial consumers' surplus is PFC and producers' surplus PCB . Cost reducing innovations reduce the per unit production costs by k from the initial equilibrium position, shifting the supply curve to S_1 . Quantity increases to Q_1 and retail price falls to P_1 , increasing the consumer surplus by the area P_1PCE . The producers' surplus increases by area P_2P_1EG . The aggregate social gain due to the cost-saving innovation is $ABCE = P_2PCEG$.

The distribution of the gains thus depends on the elasticity of the demand curve relative to the supply curve of the commodity in question. If the demand curve is perfectly elastic producers will capture all the gain from R&D and there will be no gain to consumers.

If the agricultural output is exported, the producers' surplus includes the gain to overseas producers and processors, while the gain to consumers includes the gain to overseas consumers. The proportion of the benefit flowing to all consumers can be distributed between domestic and overseas consumers according to the proportion of total agricultural production consumed by each. Where agricultural production is consumed domestically and exported for overseas consumption, then assuming no distortions in pricing in either market, domestic prices will be determined by export prices.

Figure 1: Distribution of Gains from R&D



New Zealand is a small open economy generally facing an elastic demand curve for most agricultural exports. For most agricultural export products there are many potential world suppliers and New Zealand is thus a price taker, unable to influence world prices. Scobie (1973) suggests that the aggregate elasticity of demand for agricultural exports can be taken as infinity. The gains from R&D into an export good with a perfectly elastic demand thus all accrue to producers. Since the consumers' surplus is nil, neither overseas nor domestic consumers gain. Overseas producers and processors will gain if the domestic R&D results in a cost reduction for them. When the export demand elasticity for New Zealand agricultural exports is large and the supply elasticity low, producers will gain a large proportion of the total benefits, while domestic and overseas consumers will together gain a lesser proportion. Thus the main beneficiaries of New Zealand agricultural research are likely to be domestic producers and processors.

FUNDING MECHANISMS

There are several different mechanisms for matching the beneficiaries with funding, as shown in Figure 2. It may be difficult to establish a mechanism to obtain funding from overseas consumers and producers who benefit from domestic agricultural R&D, although international negotiation between collectives for funding may be possible. Intellectual property rights such as copyrights, patents and plant variety rights may force overseas consumers and producers to pay for the use of R&D from which they benefit, although this may be more feasible for product than process R&D.

The ability of firms to appropriate the returns to agricultural R&D is an important consideration determining whether research can be efficiently funded by private sector producers or processors. Individual private firms and collectives of firms are the primary mechanisms for funding agricultural R&D where the benefits are appropriable. A government levy on agricultural output matches the beneficiaries with funding when the benefits cannot be appropriated by firms or collectives. Domestic consumers who benefit from agricultural R&D may be matched with funding through direct taxation or government levies on agricultural output.

Figure 2: Matching Beneficiaries with Funding

Beneficiaries	Funding Mechanism
Overseas Producers, Processors and Consumers	Patents, Copyrights, Trademarks
Domestic Producers and Processors	Firms Collectives - Voluntary - Industry - Multi-Industry - Regional - Government Assisted - Compulsory Agricultural Levy
Domestic Consumers	Agricultural Levy General Taxation

Firms

Market forces provide firms with incentives to invest in R&D where sufficient of the benefits can be captured to make the investment worthwhile (e.g. agricultural machinery). Mechanisms for protecting the benefits of R&D from being captured by other firms include patents, copyrights, trade secrets and monopoly power. When these mechanisms are ineffective the benefits of R&D may spill over and be captured by rival firms. Such spillovers reduce the private incentive to firms to invest in R&D because they bear the full costs of such investment but enjoy only part of the gains, which may not exceed the investment. In addition, a firm may recognize that the spillover will advantage competitors, and this may further reduce the incentive. Underinvestment in agricultural R&D by private firms may thus result. The government may be able to reduce such underinvestment, for

example by improving patent laws, if such measures are worthwhile. However, measures which improve the investment climate in general should also increase the incentive to private sector investment in agricultural R&D.

Collectives

Spillovers between firms mean that no single firm can capture enough of the benefits to make investment worthwhile (e.g. wool research). Firms which enjoy spillovers in the absence of a collective may thus be expected to form voluntary collectives to fund R&D *ex ante* and share the benefits *ex post* if the benefits can be captured within the collective and sharing is technologically feasible (Katz, 1986).

Collectives which fund agricultural R&D already exist in some industries, often as an adjunct to other activities, such as marketing. Some producer organizations directly conduct their own research, (e.g. N.Z. Meat and Wool Boards' Economic Service). The wool, meat and dairy industries fund their own agricultural R&D through Research Associations which receive around half their funding from taxation. In other industries producers also belong to levy-funded collectives which fund a certain amount of R&D, generally purchased from the public sector under research contracts. Overall only a small percentage of the total levy is spent on research, as shown in Table 1. The pattern of levy spending varies among industries, but the remainder of the levy income is generally spent on items such as promotion, advertising, marketing, quality assurance, transport, administration, crop insurance, and providing services and information.

The low expenditure on R&D and relatively high expenditure of the levy on other items suggests that industry collectives are willing to co-operate in order to fund and market their products, but that R&D may have a low investment priority. Other industries collecting levies, on which levy income and spending data is unavailable, are shown in Table 2. The existence of industry groupings suggests that industry members might be prepared to collectively fund R&D, in the absence of public sector funding, if they are prepared to collectively fund other, marketing-related activities.

Table 1: Industry Levies and Research Funding in New Zealand
Agriculture

Organization	Total Levy Income \$000	Research Funding (% Total)	Recipients of Research Funding
HORTICULTURAL INDUSTRIES			
NZ Kiwifruit Authority	7,007	2.2	DSIR, MAF, others
NZ Apple & Pear Marketing Board	-	- ^a	Various
NZ Nurseryman's Assoc.	-	-	NZ Nursery Research Centre
NZ Vegetable and Produce Growers Federation	420	11.9 ^b	Various
Tobacco Board	31	54.0	DSIR
Hop Marketing Committee	17	100.0	DSIR (Riwaka)
NZ Fruitgrowers Federation	207	12.0	DSIR, NZAEI and others
MEAT, WOOL & DAIRY INDUSTRIES			
NZ Meat Producers' Board	15,467	7.4	Not Specified
NZ Wool Board	68,801	2.5	WRONZ
NZ Dairy Board	2,300	-	DRI
NZ Milk Board	2,762	0.5	Not Specified
NZ Pork Industry Board	1,777	2.1	Massey and others
NZ Poultry Board	7,888	1.2	Mainly Poultry Research Centre
ARABLE INDUSTRIES			
NZ Wheat Board	1,227 ^b	100.0	CRD and WRI
NZ Potato Board	71	1.4	Not Specified

Source: Fordyce, 1986

a. Confidential

b. Estimated

A collective may act autonomously in arranging the conduct of the agricultural R&D it funds. It may buy R&D from private or public sector organizations (e.g. DSIR), or it may organise its own internal R&D (e.g. MIRINZ).

Table 2: Other Industries Collecting Levies

COMPULSORY LEVIES
N.Z. Berryfruit Growers' Federation

VOLUNTARY LEVIES
Dominion Federation of Chinese Commercial Growers
Avocado Promotion Council
N.Z. Babaco Growers Inc.
Blueberry Growers Association
Canterbury Flowers Export Council
Fruit Wine Makers Of N.Z.
N.Z. Garlic Growers Export Committee
N.Z. Greenhouse Grape Council
Horned Melon Association
Commercial Mushroom Growers Association
Nashi Growers Association
Export Orchid Growers Association
N.Z. Persimmon Promotion Association
National Tamarillo Association
N.Z. Fresh Tomato Industry Fund
N.Z. Tree Crops Association
National Beekeepers' Association of N.Z.

Source: Fordyce, 1986

A collective offers the advantage of appropriability of the benefits of agricultural R&D which increases with size; it allows members some influence over research programmes and priorities; and improves the accountability of sellers of R&D compared with publicly funded and conducted R&D. Collectives also offer the benefits of risk pooling and the collective funding of large scale or long-term R&D. The cost sharing in collectives raises the incentive to invest in R&D. Collectives are likely to be most effective in increasing the incentive to invest in R&D where firms are not competitors in the product market (Katz, 1986). However, the formation and maintenance of collectives incur costs which increase with the size of the collective and the heterogeneity of the interests of its members. These costs include the costs of identifying the beneficiaries or potential members, the costs of organizing and collecting levies and the costs of managing the purchase or conduct of R&D. There are also "agency costs" within collectives, where members attempt to ensure that their representatives act in their interests, and the costs which arise from the divergent interests, research requirements and priorities of members. The gains of collective action for the beneficiaries of agricultural R&D must thus be weighed against the costs in determining whether collectives will be efficient mechanisms for funding agricultural R&D.

The collectives may be of several distinct kinds, each requiring different types of government action.

Voluntary Collectives:

Voluntary collectives or associations such as those that already exist (shown in Table 1) and which fund agricultural R&D may be expected to continue, and new collectives may be expected to form in response to the adoption of the "user pays" philosophy by government. As government funding of R&D decreases, funding through voluntary collectives may increase. Firms which previously enjoyed the benefits of publicly funded agricultural R&D may be individually too small to fund R&D and capture the benefits, but may voluntarily act together to fund R&D where they can collectively capture the benefits. The government has no role in the formation or levying of voluntary collectives beyond its usual role in the maintenance of the patent system.

Voluntary collectives allow the possibility of free-riding where benefits spill over to non-members and reduce the gain to members. With voluntary membership the revenue collected and consequent investment in R&D is reduced compared with compulsory membership, reducing the aggregate size of the potential gain. However, voluntary collectives will be effective in funding agricultural R&D as long as the gains captured by the members exceed the costs of collective action and investment. Voluntary collectives usually form along industry lines. They may also form along other lines, (e.g. sub-industry, multi-industry or regional) as long as members can internalize the benefits and exclude non-members.

Multi-industry or Regional Voluntary Collectives:

Where there are benefits from agricultural R&D which cannot be captured by single industry collectives due to inter-industry spillovers, then multi-industry or regional collectives may be able to internalize the benefits. Areas where such spillovers occur include inter-industry research where there are spillovers between similar industries (e.g. grasslands research for all pastoral industries, shelter research for all horticultural industries) and research into regional problems (e.g. soil erosion research for all hill country industries). However, the monitoring and co-operation costs associated with large, heterogeneous collectives may exceed the benefits of collective action and investment in R&D. The funding of agricultural R&D which results in widespread benefits between industries and within regions in the agricultural sector may be more efficiently carried out by government levies.

Government-Assisted Voluntary Collectives:

In some industries voluntary collectives which fund R&D may be feasible, but their formation may be hampered by high transaction costs. In the present state of change in the organization of agricultural R&D in New Zealand, these costs may be large. They may be related to the patent system, the fact that industry members may not perceive themselves as beneficiaries of agricultural R&D, the fact that R&D is not considered an investment or that its payoff is seen as long term. Beneficiaries may be reluctant to join an collective if the R&D from which they benefit has historically been publicly funded or if they do not consider that they have a need to

innovate or the resources to fund R&D.

Where the transaction costs of forming voluntary industry collectives are high the government may facilitate their formation by reducing the transaction costs facing the private sector if the benefits of increased private R&D investment through the collective outweigh the costs of such action. It may be necessary to identify specific transaction costs constraining the formation of collectives before appropriate government action can be taken.

Compulsory Industry Levy-Funded Collectives:

Voluntary collectives will be effective in funding R&D insofar as the benefits of the R&D so funded can be captured within the group. Free-riding reduces the gain to members, reducing the incentive to form a collective and invest in R&D. There may be insufficient incentive for firms to form voluntary industry collectives and invest in R&D despite government actions to reduce transaction costs if free-riding persists.

Government intervention to establish compulsory membership of a collective to include all the beneficiaries may be necessary to ensure private funding of R&D through levies. Compulsory membership matches the beneficiaries with funding, reduces free-riding, increases the incentive to invest, increases aggregate revenue, increases aggregate benefits, offers the advantages of collectives and allows the industry to fund and autonomously administer its own R&D.

Government Levy on the Agricultural Sector

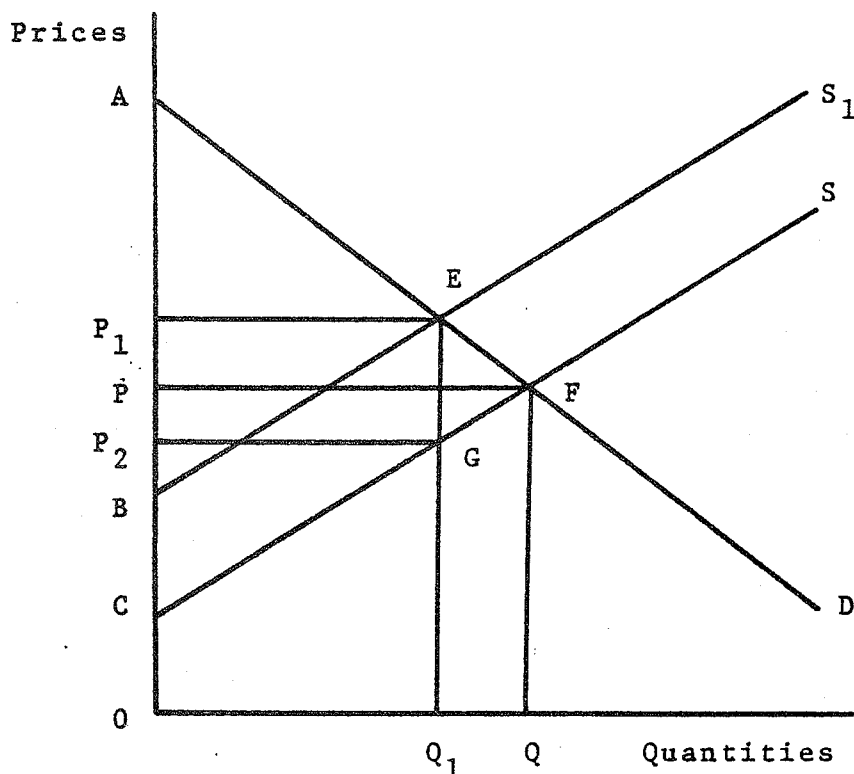
Agricultural R&D which generates spillover benefits which are limited to the agricultural sector but which cannot be captured by collectives or firms may require government intervention to induce some investment in R&D by the beneficiaries.

Direct levies may be less costly than the facilitation of large multi-industry or regional collectives and may be more efficient than general taxation at matching the beneficiaries with funding. Agricultural R&D which results in widespread benefits to regions or across industries which are not captured within costly collectives can be funded by levies, since the benefits are limited to clearly identifiable groups. Agricultural R&D which benefits future industries and where the benefits thus cannot be captured by existing industries (e.g. new plant varieties); and which benefits the agricultural sector in general (e.g. all agricultural industries benefit from soil and water research) can be funded by a levy on the agricultural sector as a whole in addition to industry levies.

Consumers in New Zealand do not in general gain from agricultural R&D. However, if domestic consumers do benefit from agricultural R&D in certain industries, then an alternative to general taxation is the collection of levies on agricultural output which would ensure that consumers contribute funding to agricultural R&D to the extent that they benefit from it. The effect of an levy or indirect tax is shown in Figure 3.

At the pre-tax price of P , consumers demand Q units of agricultural output. The imposition of an indirect tax ($P_1 - P_2$) on domestically consumed agricultural output shifts the supply curve upwards to S_1 . Consumers now pay P_1 for agricultural output, while producers receive P_2 . The total amount of indirect tax is shown by the area P_1EFGP_2 . The tax burden borne by consumers is the area P_1EFP , while the burden borne by producers is $PFGP_2$. The analysis is similar to that of the distribution of the benefits of agricultural R&D, indicating that the benefits will be distributed in an identical way to costs paid through indirect taxation.

Figure 3: Effects of an Indirect Tax on Producers and Consumers



The funding of agricultural R&D by levies involves problems related to the question of accountability, the basis on which levies should be set, the question of who should pay them and the asymmetry of the costs and benefits. Funding by general taxation also involves problems of accountability.

(i) Accountability

The disadvantage of any public funding of agricultural R&D through taxation or levies is the lack of direct accountability of the public sector to the taxpayers or payers of levies. The funders may be unable to influence the pace and direction of R&D; they may have no say in the level of overall funding or the levy rate; and they may be unable to monitor the performance of public agencies which administer R&D, since these agencies have no direct accountability to the funders, and there is no monitoring mechanism. The formation of boards comprised of representatives of the funders to control the expenditure of revenue, determine the rate and direction of funding and monitor the performance of the sellers in accordance with the

customer-contractor principle may be an imperfect solution. The imperfections arise if the funders are unable to monitor the performance of their representatives, and reward or discipline performance by a mechanism such as election. The large number of funders may also make election of representatives costly.

(ii) Levy Basis

The choice of a basis on which levies should be made should take account of the relevant advantages and disadvantages of each: the costs and benefits of each method of revenue collection; their efficiency in matching the beneficiaries with the funding of R&D; and their effects on relative prices which affect the aggregate level of agricultural output, the choice of inputs and outputs in production and the choice of consumption. Levies may be made on several possible bases. These include levies on the volume of agricultural production, where output is levied per unit; the value of agricultural production; and productive land as the residual resource to which all agricultural economic returns accrue. Most New Zealand agricultural levies on commodities, collected by the industry collectives shown in Table 1, are volume-based although some, including wool, are value-based (Fordyce, 1986).

When there are widespread spillover benefits to the agricultural sector as a whole which cannot be captured by firms or collectives, a uniform rural research levy on gross income from primary production of all agricultural taxpayers would match the beneficiaries with funding. A rural research levy of this kind has been suggested for Australia (Working Group Report to the Minister for Primary Industry, 1982, p.120). It would be equitable since every primary producer taxpayer would contribute. Such a rural levy would then be additional to the industry levies paid to voluntary industry collectives and autonomously administered by them.

(iii) Payers of Levies

(a) Where an industry comprises many commodities it may be difficult to specify which commodity will incur a levy, particularly on processed goods.

(b) New entrants to an industry may benefit from the R&D funded by existing and previous members.

(c) There may be some industries where a lack of organizational and marketing arrangements make the collection of levies difficult. Where some form of collective action already exists (e.g. marketing associations), the formation of industry collectives and the collection of levies may be easier.

(iv) Asymmetry of Costs and Benefits

The distribution of the costs and benefits of agricultural R&D is not symmetrical in a multistage production process if non-levied inputs can be substituted for levied inputs. If the levy is made at the production stage and processors substitute a non-levied for a levied input, (e.g. using improved machinery to process a given quantity of sheepmeat more efficiently) then they will escape some of the taxation burden but enjoy a disproportionate share of the benefits, and producers will incur a disproportionate share of the costs. In this case, the benefits will not be distributed in the same way as costs, so that each stage will be unwilling to fund R&D carried out in another stage of a multistage sector.

General Taxation

Where the beneficiaries of agricultural R&D are consumers then the community as a whole forms the "collective". However, the number, dispersion, diverse interests and poor organization of consumers makes the formation of a single consumer collective to fund agricultural R&D unlikely, since the costs of organizing and maintaining the collective could be expected to outweigh the benefits. This would also hold even if consumer collectives were to be organized along commodity lines. There are several additional problems in using a consumer collective to fund agricultural R&D which impose transaction costs on the formation of collectives:

(a) The benefits to consumers are less visible, more diffuse and harder to measure than the benefits to producers. It is difficult to translate the idea of economic surplus into a political argument that generates support for agricultural R&D as consumers seldom relate benefits such as lower prices or improved qualities to agricultural research and technological change, and their individual gain may in any case be small.

(b) New Zealand has historically publicly funded and conducted agricultural research, including R&D on export commodities, financed by general taxation. The current contributions by urban taxpayers amount to 80 percent of domestic agricultural R&D. However, the supply and demand elasticities of most agricultural export commodities with domestic prices set in world markets suggest that domestic consumers in general are not the main beneficiaries of agricultural R&D and that taxation-based funding is an implicit subsidy by the predominantly urban consumers to producers in the rural sector. Domestic consumers may thus not favour further taxation-based public funding of agricultural R&D.

Although it may be reasonable to assume that most consumers will also be taxpayers, it is probably not true that for all commodities all taxpayers are consumers. Matching consumers who benefit from agricultural R&D with funding through taxation may thus be imperfect. Even so, government collection of taxation or levy revenue may be less costly than direct funding through a consumer collective. Taxation or levies may be efficient when transaction costs constrain consumer investment in agricultural R&D and when the benefits of such government action exceed the costs.

Agricultural R&D may be efficiently and equitably funded by general taxation where the benefits of agricultural R&D cannot be appropriated by firms or collectives (e.g. basic research) and where the benefits are so widely diffused throughout the community that no individual or group can be identified as benefiting from the research (e.g. food safety, environmental quality).

THE ROLE OF GOVERNMENT IN NEW ZEALAND AGRICULTURAL R&D

The government has distinct roles in funding agricultural R&D, in carrying out agricultural R&D and in government action to facilitate private sector investment in agricultural R&D. Although some of these have been mentioned above, they are considered together in this section for clarity.

Government Actions

Transaction costs arise primarily from the uncertainty surrounding the sale of goods and services, and are sometimes so great that the sale is constrained or even prevented. Government action to reduce or remove transaction costs to facilitate exchange is costly, and constitutes a private sector subsidy. There is little more reason for the government to bear these costs than there is for it to subsidise production generally. However, government actions which are aimed at other goals may also have the effect of reducing the transaction costs of private sector investment in R&D (e.g. the removal of economic distortions). The costs of some government actions, such as the formation of compulsory collectives, may be recoverable through levies. If government action is aimed at improving efficiency (i.e. reducing costs), it should be undertaken only if the return is worthwhile in terms of increased investment in agricultural R&D.

Government action may take several forms, each related to the amelioration of the effects of transaction costs on private sector investment:

- (i) The government may be able to reduce the transaction costs of investment in agricultural R&D facing private firms. Such measures may involve the removal of economic distortions and improvements to the patent system. Measures which improve the investment climate in general are likely to increase investment in R&D.
- (ii) The government may be able to facilitate the formation of voluntary collectives where transaction costs limit collective action. Government actions could include improvements to the patent system. It may also be necessary to identify specific transaction costs constraining collective formation before appropriate action can be taken.
- (iii) The government may form compulsory collectives where the persistence of free-riding prevents the formation of voluntary collectives despite government action to reduce transaction costs. Once the collectives are formed no further government action is required in collecting levies or administering the purchase of R&D. Government actions to institute compulsory collectives include:
 - (a) identifying the beneficiaries,
 - (b) legally setting up a collective and defining the membership, and
 - (c) setting levies.
- (iv) The government may form boards which include representatives of taxpayers and payers of levies to improve the accountability of government agencies and increase the role of the market in determining the rate and direction of agricultural research.

Government Funding

The government may fund agricultural R&D through levies on the agricultural sector and general taxation. Both impose costs on the public sector.

- (i) The government may impose a levy on agricultural output where agricultural R&D results in benefits which are limited to the

agricultural sector, but which are not captured by firms or collectives. Research which benefits consumers and research into new agricultural industries could also be funded in this way.

(ii) The government may fund agricultural R&D through general taxation where the benefits are not limited to the agricultural sector and cannot be appropriated private sector firms or collectives; where the benefits are so diffused among the members of society that the costs of identifying the users and exacting payment outweigh the benefits; and where consumers benefit from agricultural research.

Government Conduct

In New Zealand the public sector has traditionally both funded and carried out agricultural R&D. However, the implementation of recent policy changes suggests that the role of the government in conducting R&D will change.

(i) The government may conduct routine agricultural R&D for sale to private sector firms and collectives (e.g. laboratory services). However, the reduction in transaction costs facing the private sector suggests that private sector sellers of R&D may enter the market, and increased competition may reduce public sector conduct and sale of this type of agricultural R&D.

(ii) The government may conduct agricultural R&D for sale to private sector firms or collectives where the assets of the government agency are specific to the buyer (e.g. long term development contracts with particular industries). However, the formation of collectives and the presence of contracting costs suggest that the specific assets may be taken over by the firm or collective where the benefits exceed the costs.

(iii) The government may buy agricultural R&D, in cases where public funding is justified, from private sector sellers. However, the transaction costs associated with the purchase of certain kinds of agricultural R&D from the private sector under contract may make public sector conduct a more efficient alternative since the traditions of public service may be perceived as an implicit guarantee of performance. This may be particularly true of R&D where contracting costs are high, where there is a threat of opportunism, where monitoring the sellers is difficult, and where it is difficult to specify research requirements (e.g. basic research). However, the costs associated with bureaucracy in government and the public conduct of R&D may be high and must be weighed against the costs of private sector purchase of R&D.

CONCLUSION

The transaction cost approach compares the relative efficiency of alternative institutions in organizing economic activity, including R&D. Although all market institutions are imperfect due to the presence of transactions costs surrounding all exchanges, this "market failure" does not necessarily imply that government provision

is mandatory where the market is inefficient in supplying R&D. There are a number of ways, including provision, in which the government can act to influence the level of R&D investment in the economy. The choice of government actions and funding and conduct policies to redress the "failure" of markets in agricultural R&D should include a realistic appraisal of the associated costs and benefits of each, as governments as well as markets are inherently imperfect and "fail" due to the presence of transaction costs, and they may in fact have fewer incentives to be efficient than markets.

The transaction costs approach to agricultural R&D indicates the relative efficiency of various private and public sector funding mechanisms of agricultural R&D. The available evidence suggests that domestic producers and processors, rather than domestic consumers, are the main beneficiaries of agricultural R&D in New Zealand. Domestic producers and processors can be expected to fund agricultural R&D through private firms or collectives of private firms, where they can appropriate sufficient of the benefits to make the collective action and investment in R&D worthwhile. Where private investment is constrained the government may have a role in reducing transaction costs. Government actions include improvements to the investment climate in general and improvements to the patent system. The identification of specific transaction cost constraints may be necessary before appropriate action can be taken. If free-riding persists despite transaction cost reductions government formation of compulsory collectives enables identifiable groups of beneficiaries to fund R&D. A government levy on the agricultural sector where R&D results in widespread benefits which limited to the agricultural sector but not captured by firms or collectives matches all beneficiaries with funding. An agricultural levy could also fund R&D into new crops and R&D which benefits consumers. General taxation may fund agricultural R&D which benefits the nation as a whole. The accountability of public sector funders to taxpayers and payers of levies may be improved by the formation of a board or boards to oversee levy expenditure and the direction and pace of agricultural R&D.

Clearly, the implications of this approach suggest that in the long run the public sector will play a reduced role in agricultural R&D, funding those areas where the R&D is inappropriable or where the costs of forming collectives exceed the benefits. The asset-specificity of the public sector may permit it to continue to conduct R&D funded by private sector firms and collectives in the short run. However, in the long run the increase in private sector sellers of R&D will reduce the asset-specificity advantage enjoyed by the public sector, and its role as a seller of agricultural R&D may decrease. The costs involved with the sale of R&D where asset-specificity is high may lead to internal organization by private sector buyers. Where agricultural R&D is publicly funded, it may be purchased from private or public sector sellers. The costs associated with bureaucracy and public sector conduct of R&D must be weighed against the contracting costs of purchase from the private sector in determining the efficient organization of the conduct of publicly funded agricultural R&D.

In the immediate future, however, where industry collectives are not operational, users of R&D cannot be easily identified and the farming sector has a reduced investment capability, the government may be

justified in maintaining a level of funding which will not reduce the future payoff to R&D while implementing policies to reduce the transaction costs of undertaking R&D for the private sector, facilitating the formation of voluntary and compulsory collectives, instituting levies on the agricultural sector and establishing boards to act in the interests of taxpayers and payers of levies. In other words while there are sound theoretical reasons to expect a smaller level of public funding for agricultural R&D than has traditionally been the case, the timing and sequencing of the policy changes need to be examined. Substantial short run reductions in the overall level of public and private investment in agricultural R&D are likely to imply a reduced rate of growth in agricultural productivity in the future.

REFERENCES

- Arrow, K.J. (1962). Economic Welfare and the Allocation of Resources for Invention. In *Economics of Information and Knowledge*, D.M. Lamberton (ed.), pp.141-159, Penguin, Harmondsworth.
- Arrow, K.J. (1969). The Organization of Economic Activity: Issues Pertinent to the Choice of Market versus Nonmarket Allocation. In *Public Expenditure and Policy Analysis*, R.H. Haveman and J Margolis (eds.), pp.47-64, Rand McNally, Chicago.
- Baumol, W.J. (1986). Williamson's *The Economic Institutions of Capitalism*. *Rand Journal of Economics*, 7(2):279-286.
- Beattie, D. (1986). Key to Prosperity: Science and Technology. The Report of the Ministerial Working Party. November, 1986. Wellington. 129p.
- Blyth, N. (1983). A Note on the Elasticity of Demand for New Zealand Sheepmeat Exports. *New Zealand Economic Papers*, 17:117-121.
- Edwards, G.W. and Freebairn, J.W. (1981). Measuring a Country's Gains from Research: Theory and Application to Rural Research in Australia. A Report to the Commonwealth Council for Rural Research and Extension, Australian Government Publishing Service, Canberra. 154p.
- Edwards, G.W. and Freebairn, J.W. (1982). The Social Benefits from an Increase in Productivity in a Part of an Industry. *Review of Marketing and Agricultural Economics*, 50:193-210.
- Edwards, G.W. and Freebairn, J.W. (1984). The Gains from Research into Tradable Commodities. *American Journal of Agricultural Economics*, 66(1):41-49.
- Eveleens, W.M. and Scobie, G.M. (1986). Efficiency and Equity in Agricultural Research. Discussion Paper 6/86, MAF Economics Division, Hamilton.
- Fordyce, A.M. (1986). Industry Levies and Research Funding. Technical Report No. 24, DSIR Plant Physiology Division, Palmerston North.

- Freebairn, J.W., Davis, J.S. and Edwards, G.W. (1982). Distribution of Research Gains in Multistage Production Systems. American Journal of Agricultural Economics, 64(1):39-46.
- Jardine, D.V.A. (1986). Funding and Conduct of Research and Development - Theory and its Application to New Zealand Agriculture: A Transaction Costs Approach. Unpublished M.Soc.Sc. Thesis, University of Waikato, Hamilton, 220p.
- Katz, M.L. (1986). An Analysis of Co-operative Research and Development. Rand Journal of Economics, 17(4):527-543.
- Martin, C., Molloy, B. and Scobie, G.M. (1985). Report of a Review Team on the Funding of the New Zealand Agricultural Engineering Institute. MAF, 24p.
- O'Donnell, D.K. and Troughton, J.H. (1986). Economic and Policy Framework for Science and Technology in New Zealand. DSIR Discussion Paper No.13, Wellington.
- Scobie, G.M. (1973). The Price Elasticity of Demand for New Zealand Exports: Theory and Estimation. New Zealand Economic Papers, 7: 1-24.
- Ulyatt, M.J. (1986). Research and Development Funding in Agriculture. New Zealand Institute of Agricultural Science, 29p.
- Williamson, O.E. (1985). The Economic Institutions of Capitalism. The Free Press, New York, 450p.
- Working Group Report to the Minister for Primary Industry, (1982). Agricultural Policy: Issues and Options for the 1980s. Australian Government Printing Service, Canberra, pp.115-134.

SUSTAINABLE AGRICULTURE IN THEORY AND IN PRACTICE

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SUMMARY

Future management of the world's resources depends upon reconciling the needs of socio-economic development with the conservation of the world's environment. A strategic framework that permits understanding and managing the long-term, potentially large-scale interactions between these requirements, based upon the sustainable development of the natural resources of the biosphere, is needed. Can modern agriculture with its sophisticated scientific support base assure sufficient food and fibre production in the future? Are available agricultural resources capable of supporting ever increasing populations? How do different technological paths influence the natural and social environments of rural people? How is it possible to distinguish between the sustainable and the unsustainable? Questions like these form the core of the notion of sustainability. Thus far, however, the concept remains vague and subject to all sorts of different meanings. This paper explores the concept's operational significance as a guide to public policy.

Key Words: Sustainability, Agriculture, Agroecosystem, Theory, Practice, Future Generations.

INTRODUCTION

There is an emerging interest throughout the world in the adequacy of the natural resource base to sustain economic development. The unprecedented increase in living standards in the last century and a half have occurred because of the increased depletion of nonrenewable resources (e.g. fossil fuels) and the unsustainable rates of renewable resource use (e.g. ocean fisheries, native forests). Unfortunately, since the long term consequences are very difficult to comprehend, the policy choices and consequences will always be matters of great speculation. Eventually, though, socio-economic systems will be forced to be more dependent on flow rather than stock resources, more careful not to degrade the natural environment irreversibly, and more earnest to learn to manage the biosystem more productively.

In agriculture, the avoidance of harmful side-effects of high output technologies can require limiting the use of erodible soils, the use of proper drainage in irrigation areas, the improved management of slowly degrading resources like water and soil, the avoidance of chemical buildups in soil and water and food, and the reliance on monocultures which pose future risks for preservation of genetic diversity. In each of these cases there are significant, near-term costs. Especially for developing countries, the tradeoffs between immediate known benefits and the less well understood long term sustainability of the system can be a cruel choice. Indeed, the need for rational, objective decisions about the management, future development and possible depletion of natural resource systems in agriculture is very great.

The term sustainability is unequivocally an assertion about the future. Can certain agricultural practices better conserve, maintain and enhance productivity and quality of human life in perpetuity? Sustainability might also be thought of as a process through which resource management systems evolve to permit regeneration (Altieri, 1986) or the coevolution of the man:environment system (Norgaard, 1984). In a dynamic conception of the process of change, sustainability also stands for an increasingly sophisticated approach to the definition of problems, the analysis of resources and environmental issues, and the management of complex farming systems. It implies a long term commitment to farmers, educators, researchers and to future generations. In fact sustainability can mean just about anything to anybody. This is the problem addressed in this paper.

The paper is more an ambivalent review of the literature than a critical analysis of the subject. It is perhaps most accurately described as an exploratory effort by the author to examine the workability of the concept in the broader field of natural resource management, particularly in the case of renewable resource systems. This spirit of ambivalence is important to stress since the

author neither fully understands all the issues nor is willing to adopt a particular stance (knowingly) at this juncture. It may be interesting to note in passing that by far the majority of print devoted to the notion of sustainability concerns agriculture.

The balance of the paper is organised as follows. The next section reports a brief overview of three contrasting philosophical approaches which employ sustainability in significantly different ways. Each appears to draw upon a different epistemological basis for theoretical support and guidance in problem definition and problem solving. What emerges is a transdisciplinary view of sustainability that is mutually supporting, but in which no particular disciplinary perspective is dominating. The next section briefly outlines the concept of agroecosystem which seems at the present time to best reflect this multidisciplinary approach in agricultural research. The concluding section presents some ideas on New Zealand research needs where the concept of sustainability appears potentially useful.

THE MEANINGS OF SUSTAINABILITY

This section draws heavily on a collection of recent conference papers edited by William Lockerety (1983), Gordon Douglass (1984), Thomas Edens, *et al.*, (1985) and the University of California Committee (1986). In particular it employs a philosophical taxonomy suggested by Douglass which has considerable merit as an integrating framework. While many views expressed about sustainability are unique in their own right (extremism is no vice on this issue!), they boil down, more or less, to belonging to one of three intellectual camps. They are the: 1) economic -- food sufficiency, "dynamic market equilibrium" -- school; 2) ecologic -- stewardship, "ecologically-driven, evolutionary systems" -- school; and 3) sociologic -- community development ("...a sustainable agriculture does not deplete soils or people...") -- school. Each of these schools or intellectual traditions contain epistemologies that are in some cases at considerable odds with each other. Accordingly, the full meaning of sustainability, in its theoretical and operational sense, can only be attempted within this uneasy (intellectually tense) environment of competing world views. Indeed, this appears to be the concept's most fundamental nature.

The Economics

It should come as no surprise that the basic strengths of neo-classical economic thought are cited by its critics as its fundamental weaknesses. The shortcomings of applied welfare theory to agricultural and natural resource policy analysis are well known to this audience and need not be restated here. One matter of major importance, however, should be emphasised: the profound

inability of economic theory to deal effectively with the futurity problem (Page, 1977; Norgaard, 1986a; Just et al., 1978). In fact, the policy sciences in general would appear ill-informed about sustainability issues except in the most prosaic sense (Norgaard, 1986b).

Sustainability equates to "food sufficiency" which focuses on aggregate supply and demand, nearly always in the short to intermediate (20 to 30 year) term. World-wide conditions guide agriculture. The demands for economic growth (via population growth) induces supply increases via international market forces. Increased system throughput increases demands on resources and productivity-enhancing technology. "If introduction of new techniques leads to greater erosion, ... the cost of low fertility can be justified [internationalised by the production system] as long as technology advances yield more than commensurate [to compensate]. Agriculture, in this view, is primarily an instrument for feeding the world, and preservation of the resource base is decidedly of secondary importance" (Douglass, 1984, p.1-2).

The accepted views within this school (e.g. Farrell, 1984, and Ruttan, 1984; and Wittwer, 1983) lead one to hypothesize a future of more of the same: fewer and larger farms, more mechanisation, greater use of agrochemicals, greater farm and regional specialisation, greater environmental impacts. Virtually no real importance is attached to the question of the sustainability of rural agricultural communities. It would be wrong to think of agriculture as anything more than a business. That prominent script above the Hilgard Building on the U.C. Berkeley campus that says "To Rescue for Human Society the Native Values of Rural Life" belongs to a bygone era.

The Ecology

This school, which represents the intellectual antecedents of a rather diverse amalgam of physicists, biologists, systems theorists, naturalists and the like, equates sustainability with stewardship (Figure 1.). The world view is decidedly ecological: an agricultural system which needlessly depletes, pollutes, and disrupts the ecological balance of nature is clearly unsustainable. It is a very long run perspective on how natural systems operate, and evolve. A biological rather than industrial basis for agricultural productivity is necessary for a sustainable agriculture: the latter will inevitably fail mankind.

Most writers in this camp "...see in natural ecosystems a generic model for designing stable, self maintaining ecological systems tailored to suit local variations in knowledge, climate, soils and biological diversity" (Douglass, 1984, p.146). Some (Altieri, 1984; Conway, 1987) specify requirements for sustainable agroecosystems; others interpret sustainable strategies from the

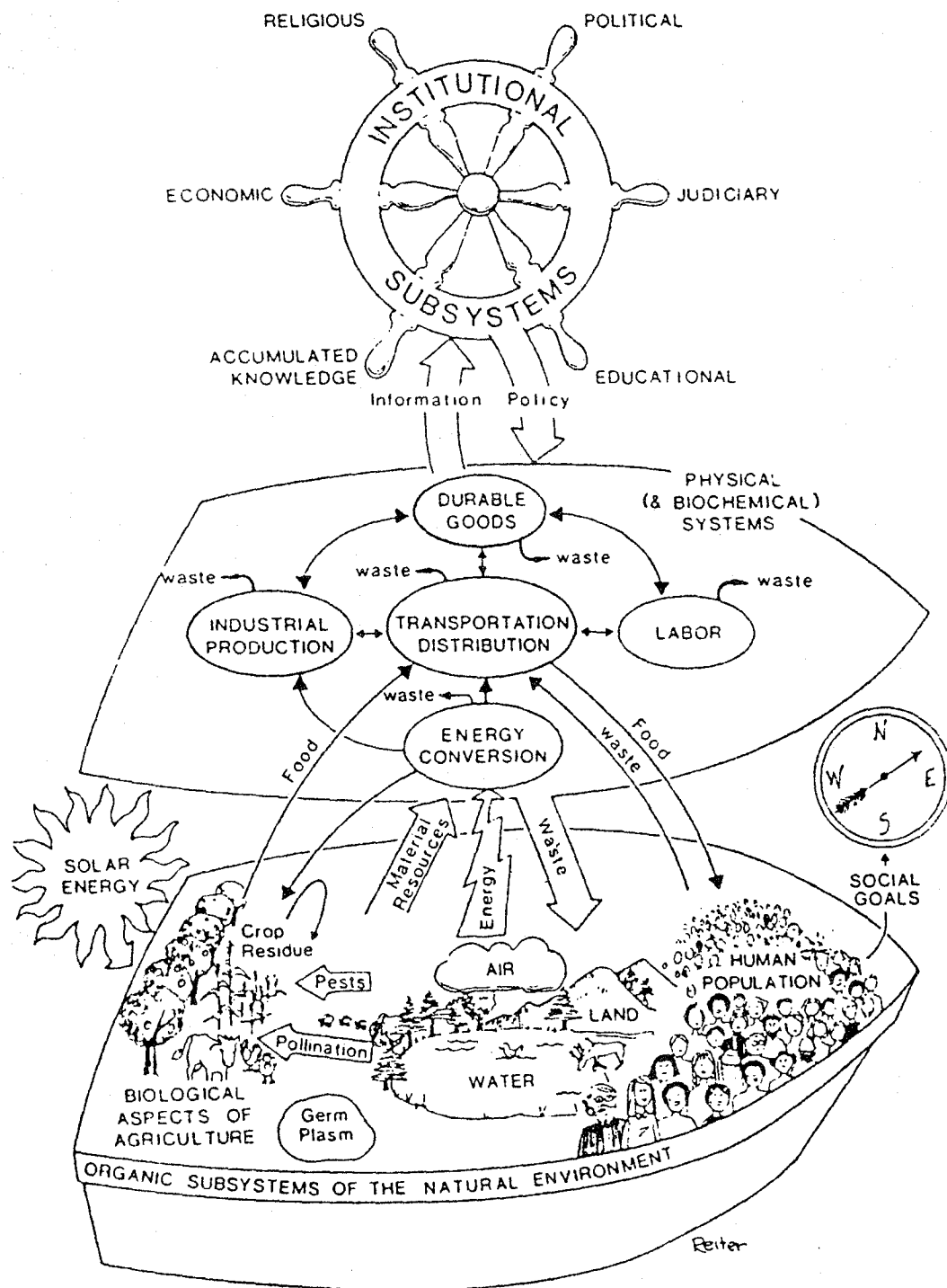


Fig. 1 The spaceship earth (Edens and Haynes 1982).

study of traditional agriculture (Boserup, 1965; Cohen, 1977). An important argument for learning more about present agroecological systems is that the pace of modern development -- stimulated by the Green Revolution and the "more-market" philosophy -- could destroy this potentially valuable knowledge base (and gene pool). Science is not seen as a reliable way to avoid the risk of this potentially irreversible loss.

The Sociology

This school views sustainability as inherently human. It is synonymous with the concept of human community. As with the sustainability-stewardship school, they readily recognise the need for a clean, healthy environment and sustainable uses of biological resources. However, their central focus is on the values to be derived from the natural environment that promote rural culture and well-being, of which stewardship, selfsufficiency and community vitality are paramount. The theological underpinnings of this idea of sustainable communities is reflected by the argument that human beings should not be thought of as factors of production whose mobility is important to the health of the economic system. They are the ends not the means.

The agriculture of Sri Lanka and the National Heritage movement provide a penetrating insight into what this perspective means to developing countries, and particularly to minority cultures with a longstanding agrarian tradition. "Natural Heritage is a sophisticated ideology based upon the traditions of the past, an interpretation of the present, and projections for the future. The assumption which infuses the ideology is that there is much of merit in Sri Lanka's traditions and, before they are destroyed by the encroachment of Western oriented, materialistic philosophy and lifestyle, it is vital to the national interest to explore and save, if at all possible, what is valuable." (Douglass, 1984, p.245). Rural communities have co-evolved with their environment over long periods of time and much can be lost if this is not recognised and passed on to future generations.

An Integrated Approach?

The agroecosystem model may represent the development of an integrated approach to sustainability in the making. It is compatible with materials balance concepts widely used in interdisciplinary research --especially by natural resource economists -- and it parallels in many respects the conceptual structure of constrained economic optimisation theory. The integrating discipline may in fact be systems theory (Boulding, 1979).

THE AGROECOSYSTEM CONCEPT

Agroecosystems are ecological systems manipulated by man to produce specific goods and services. Because the end products have social value, agroecosystems are cybernetic systems which can be optimised according to stated objectives. In contrast, the ecosystems they replace are often more structurally and dynamically complex and are frequently difficult to characterise in practice. While the concept of ecosystem is well established, the boundaries can be obscure (Tansley, 1935). Conway (1987) argues that agroecosystems can be characterised by a limited set of dynamic properties, and this in turn allows their essential behaviour to be described and their performance evaluated according to a standard set of objectives or normative criteria. This view of agroecosystem seems generally consistent with the conventional framework of economic analysis.

Cross-Disciplinary Thinking

The transformation of ecosystem to agroecosystem reduces the great diversity and complexity of the original natural system to a restricted set of plants and animals. This is illustrated in Conway's example of the ricefield, Figure 2. (Conway, 1987). The bio-physical boundary of the system becomes less permeable with the creation of irrigation networks. The basic ecological processes of competition, predation, etc remain but are now regulated by agricultural processes such as cultivation, fertilisation, harvesting and marketing. The system boundary takes on a socio-economic character because human cooperation (and competition) define the system goals. Hence it is this new complex of agro, socio, eco and economic system dimensions that is embodied in the meaning of "agroecosystem". Defined in this manner we can envisage a hierarchy of systems and subsystems which may be relevant for different purposes of analysis. For example, at the bottom of the hierarchy would be the individual plant or animal and its micro-environment. The next level might be the crop or herd agroecosystem, continuing on through livestock system, farming system, household, community, catchment, region, nation, economic community, etc. A world agroecosystem would consist of national agroecosystems linked by international trade.

Simon (1962) argues that the study of hierarchical systems is confounded by the problem of composition, and this has important implications for agricultural policy. Higher systems are not always understood through the study of lower systems, consequently the behaviour of the agro-ecosystem at each level must be understood in its own right as well as its relation to lower and higher levels. If systems theory is correct, then planning and policy analysis based 'largely' on the perspectives of macro-level economic policy, genetic engineering or farming systems research must be incorrectly focused, i.e. potentially in error. Systems theorists argue that

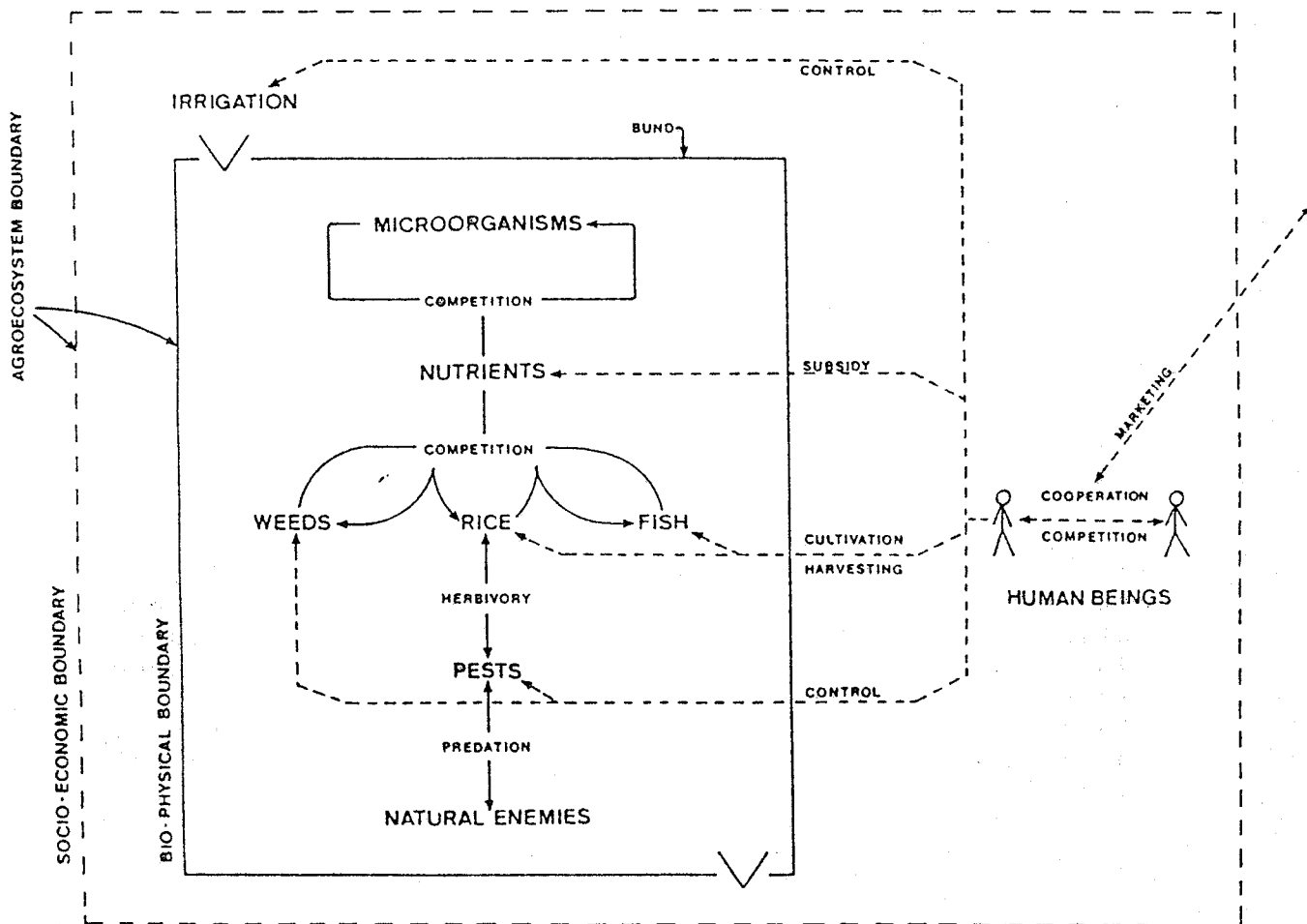


Fig. 2 The ricefield as an agroecosystem.

Conway 1987

this sense of "totality" in understanding can only be achieved with a common approach to analysis, and this implies that a well defined set of system properties exists to relate the levels of the hierarchy to each other.

Ecologists use terms like productivity, stability and resilience to describe the basic properties of plant and animal communities (Holling, 1978). As mentioned earlier the 'goal' of an agroecosystem can be defined in terms consistent with welfare economics. The goal measure, "social value", is a function of the goods and services produced by the agroecosystem, their utility in satisfying human needs, and their allocation among the human population (Conway, 1987). Further, social value has several readily measureable components: the present production (and its economic efficiency), its likely level of provision over a future time horizon, and its distributional (equity) implications. Since any agroecosystem at any level in the hierarchy can have social value, it follows that one form of an agroecosystem could be preferred to the others because its social value is greatest.

Operational Considerations

In practice the agroecosystem model suffers from the same abstract conceptual basis as welfare economics: the concepts involved in defining social value are of limited practical use. Consequently, any assessment of an agroecosystem's performance must be focused on the principal system properties that determine goal achievement, not the abstract goal measure itself. Four such properties, common to all agroecosystems, have been suggested: (1) productivity, (2) stability, (3) sustainability, and (4) equity (Altieri and Anderson, 1986). The first three are defined in terms of the socially-valued output and may be measured in both physical and socio-economic units. The notion of equity (distributive justice) as a property of an agroecosystem has no natural counterpart in ecological systems.

Productivity is the measure of output per unit of input, and can be expressed in all the conventional ways -- dollars, calories, kilograms. The input/output accounting framework may also be used to measure related performance variables, for example employment creation, the provision of recreational and environmental amenities, among others. The combinations of input and output (productivity ratios) are the efficiency measures used to evaluate alternative or competing agroecosystems (Carter and Lohr, 1986). Analyses may be undertaken at the same or different levels in the hierarchy and between different types of agroecosystems (e.g., lowland vs hill vs high country pastoral systems).

Stability is defined as the constancy of productivity over time. Change is induced by the surrounding environment, including such causes as physical, biological, social and economic forces which are exogenous to the agroecosystem under study. The measure of stability is the appropriate statistical measure of the variation observed in the productivity time series. Hence, stability refers to variation about the trend where productivity may be rising, falling or constant. It is implied, if not always stated, that the disturbing forces are small and ultimately predictable within reasonable margins of error.

Sustainability refers to the ability of an agroecosystem to maintain or regain productivity after a major disturbance. The disturbance may result from a catastrophic, unforeseen event or "shock", but most generally will be an intensive "stress" caused by an accumulation of small, predictable disturbances over time. Shocks are characterised as unpredictable -- a new pest, a rare event such as drought, or a market collapse -- whereas the cumulative effects of stress are more gradual and potentially knowable. The latter are like a systems myopia: --declining market demand, soil erosion, pesticide, resistance, chemical toxicity of groundwater and other changes are not perceived in their totality. Thus sustainability means the durability of productivity under known or possible conditions.

Orians (1975) suggests various conceptual measures for sustainability (for example, hysteresis, elasticity, inertia, amplitude) but these have little practical value in other than the ex-post sense, analytically. The more useful measure would be in the ex-ante sense: How is the sustainability of an agroecosystem to be judged based on current cultural practices? A partial answer to this question lies with an understanding of the nature of the "subsidies" necessary to maintain productivity of the agroecosystem. Fertiliser, pesticides, fossil energy, scientific knowhow and other inputs aim to mitigate stress in agroecosystems. For example, in Figure 3 four different possible effects of pest management are illustrated. The use of pesticides can have several types of consequences, ranging from productivity maintenance with continued use (as intended) to productivity collapse even with increased use (unintended resistance or toxicity). It may be possible that a biological control agent could supplant chemical control all together. Three of the four cases illustrated meet the definition of sustainability, but they do not provide a complete answer to the question of choice. Another example of the use of agroecosystem properties is Altieri's (1986) Critique of California agriculture (Figure 4). One important issue not depicted in Figures 3 or 4 is the relative risks of input use unrelated to productivity of the agroecosystem.

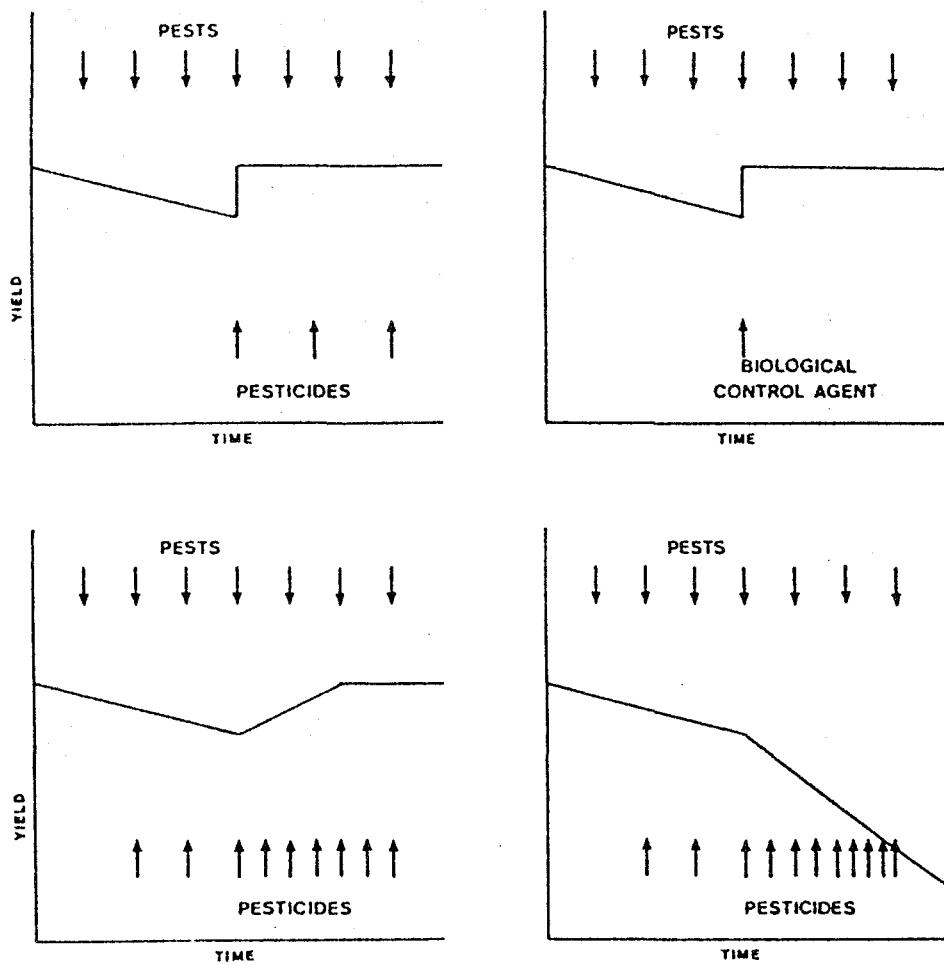


Fig. 3 The effect of pest control on sustainability.

Conway, 1987

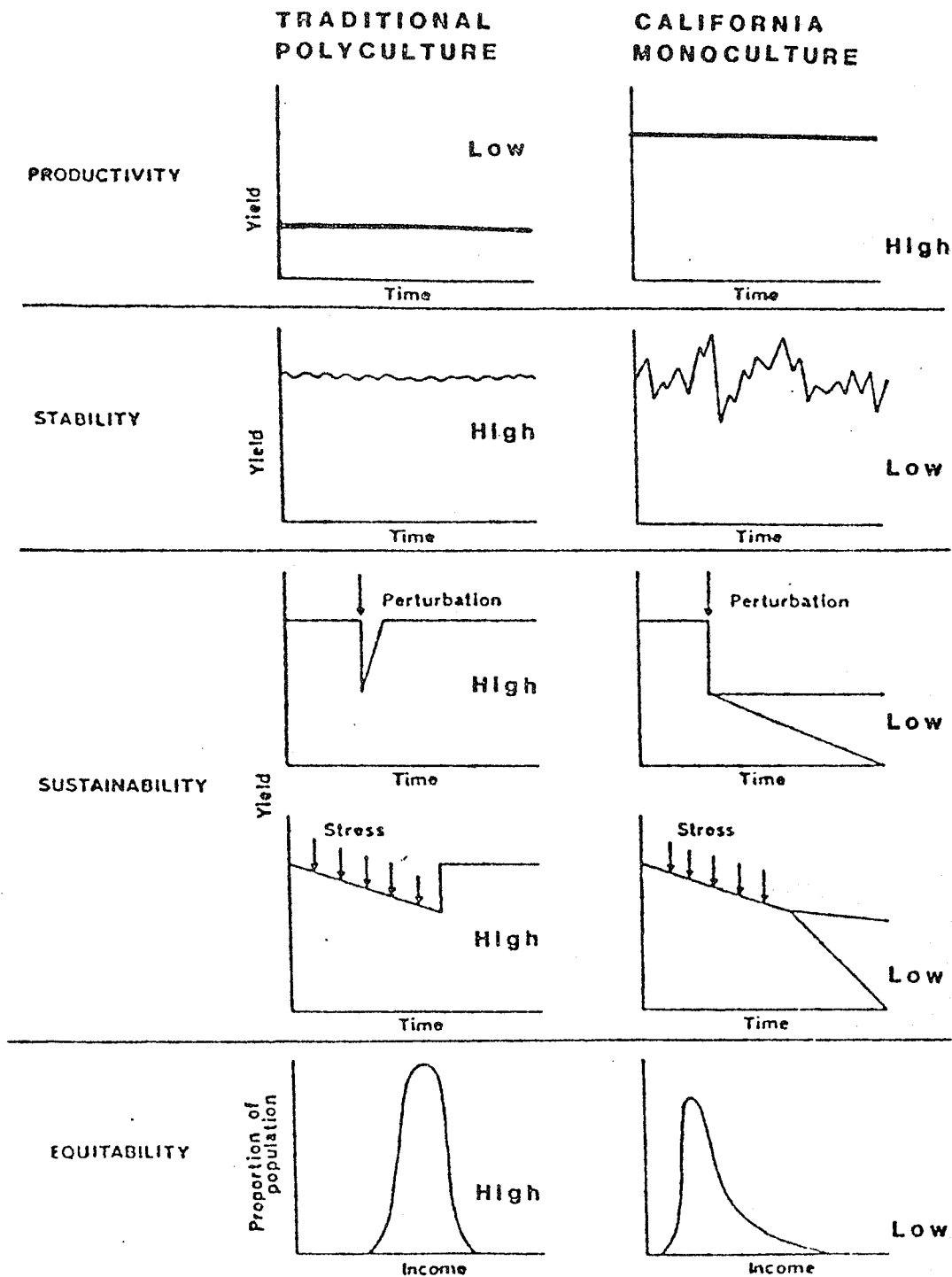


Fig 4 . The system properties of agroecosystems and indices of performance (modified after Conway 1985). California agriculture exhibits high productivity, but low values of stability, sustainability and equitability.

Equity concerns the distribution of goods and services according to the governing rules of the human institutions which are part of the agroecosystem. These can be quite arbitrary: from laissez-faire to purely dictatorial. The fairness of the distribution may ultimately feedback into productivity of the system (for example, via the structure of incentives between capital, land and labour). Measure of equity are typically obtained with the use of Lorenz curves, Gini coefficients or similar indices (Fields, 1980).

Besides these four primary properties there are other ways to characterise agroecosystems. For example, the descriptors material conservation, energy intensity, pesticide residuals, autonomy, self sufficiency, cultural acceptability, etc are often used to describe agroecosystems and processes. However these features can all be shown to contribute to one or more of the primary system properties. Further these properties are linked with each other both within and between agroecosystems at different levels in the hierarchy. Since the linkages can be complimentary and competitive, they should be regarded as "normative indicators of performance" rather than neutral descriptors (Conway, 1987).

The tradeoffs between the normative performance criteria can be significant. For example, stability and sustainability at the farm level may depend upon a diversity of crop and livestock systems, each perhaps less productive than its maximum potential and individually less sustainable than the total farm. Such risk-spreading through diversification is a common feature of most traditional farming systems. The tradeoffs between the primary properties comprise, in effect, a range of distinctive agroecosystem strategies. This information can become a powerful explanatory tool for the analysis of historical agricultural systems or system change over time. There are many good examples of how agroecosystem thinking has helped to explain the dynamics of agricultural change. Several of these are briefly reviewed in the following section.

Some Recent Applications

A popular use of agroecosystem theory is its role in the historical explanation of system failure. Man's relationship to the natural environment, and nature's influence or the cause and quality of human life, are among the oldest topics of speculation (Barnett and Morse, 1963). Understanding the origin, flowering and decline of pre-modern (agricultural) economies provides insight into the possible long-term consequences of present resource use and misuse.

Bender (1975), Cohen (1977) and Rindos (1984) trace the origins of agriculture throughout the world and conclude that productivity and stability were the overriding concerns of early society. There were consequences for sustainability and equity however. The Mayans, Mesopota-

mians and Carthaginians -- who lived in an era when environmental stress mounted slowly -- apparently did not understand the forces at work which undermined their flourishing societies. Their agroecosystems collapsed because the consequences of salinity, erosion and population pressure meant they could not be sustained. Conversely, some forms of intensive agriculture have been successfully practical in Asia for over 40 centuries (King, 1927). Spain has some of the world's oldest existing irrigation systems and institutional arrangements yet they are "models" of economic efficiency and equity by today's standards (Maass and Anderson, 1986). Watt (1986) summarises the growing consensus among these analysts: ... "the most important destabilizing forces operating on socio-economic-environmental systems may be outside the systems themselves. This is a plausible idea... any living system has persisted a long time [because] it has evolved internal self-stabilizing ... mechanisms that tend to maintain [itself] and thus decrease the probability of system extinction." (p.2).

Aston (1981) describes one of the world's oldest agroecosystems -- the British manorial system -- which existed from the 7th to 14th Centuries. The basis of the system's sustainability was a field rotation of fallow, followed by a sequence of grains and legumes and then back to fallow. The system reduced the incidence of pest losses and made use of available manure. Village council (institutional arrangements) were important in controlling cultural operations, animal grazing intensity and tenure. Equity was apparently a major concern in this system as reflected in fairly rigid rules applied in the distribution of cropland and grazing rights. While grain yields were low there was remarkable stability in the productivity over many centuries. The system eventually broke under the pressures of population, soil fertility exhaustion, and social revolution. The enclosures of open lands to produce individual estates and land holdings resulted in marked productivity increases, and with the scientific revolution of the 18th Century this high productivity became sustainable via intensive recycling of crop and animal waste.

How sustainable is modern agriculture? The dramatic increase in productivity in the 20th Century is without parallel in human history. So too is population growth, soil erosion, waste discharge, exhaustion of water supplies and some other strategic inputs, and the incidence of institutional responses to perceived social and economic problems such as agricultural protectionism (Crosson and Brubaker, 1982, Brown, 1980). Until the last several decades many of the major agricultural regions of the world were different from each other in terms of the relative importance of agroecosystem properties. Conway (1987) points out, for example, that the 'dust bowl' occurred in the United States at a time when conservation agriculture was widely practiced in Europe. Today, however, the pursuit of high productivity agriculture in

both developed and developing countries poses questions of long term sustainability which are mutually shared. Sustainability and equity properties of agroecosystems are emerging worldwide research agenda issues.

RESEARCH IMPLICATIONS

The extent to which low-input, low-chemical alternative agriculture systems have been adopted in the United States is quite significant (CAST, 1980; USDA, 1980; OTA, 1982). For example, the extent of conservation tillage in 1980 was estimated at about 65 million acres. In the same year there were approximately 45,000 commercial organic farms. However, the number of farmers that practice some form of sustainable agriculture at the present time is not known. The studies that have been undertaken to date indicate with conventional farms in terms of net income. Yields of crops and livestock are typically lower on organic farms. However, the number of farmers that practice some form of sustainable agriculture at the present time is not known. The studies that have been undertaken to date indicate that these farms generally compare favourably with conventional farms in terms of net income. Yields of crops and livestock are typically lower on organic farms, but this is offset by less expenditure from fewer purchased inputs. Comparative assessments of alternative farming practices are still hindered, however, by inconsistent methods of inputting values to unpriced inputs such as family and operator's time. So far there are very few similar studies on sustainable farming practiced in New Zealand.

Using the U.S. experience as a guide, one of the first questions that deserves resolution in New Zealand would be the broad information needs. such as:

- pest resistance to pesticides?
- decline of soil productivity and nutrient loss through erosion and other practices?
- future supplies and costs of farm energy, concentrated nutrients and petrochemicals?
- health hazards to humans and animals?
- damage to beneficial insects and wildlife?
- food quality and handling requirements?
- decline of country towns and family farms?
- reduced environmental amenities and assimilative capacities?

- restrictive government policies and market failures?
- adequacy of farmer, consumer, researcher and supporting information systems (concerned about sustainability)?

The next steps would be to identify and examine the range of options available for taking a closer look at some of these present and emerging problems. Good candidates in this exercise are the many institutional arrangements which clearly have great potential for impacting farmer and public decisions both negatively and positively. Other logical needs will include case studies of specific problems in order to develop the appropriate methodologies with which to effectively deal with them.

BIBLIOGRAPHY

- Altieri, M.A. (1983). *Agroecology : The Scientific Basis of Alternative Agriculture*. Division of Biological Control, University of California, Berkely, California.
- Altieri, M.A. (1986). *Ecological Diversity and the Sustainability of California Agroecosystems*. In U.C. Committee (1986).
- Barnett, H.J. and Morse, C. (1963). *Scarcity and Growth : The Economics of Natural Resource Availability*. Johns Hopkins University Press, Baltimore, Maryland.
- Bender, B. (1975). *Farming in Prehistory : From Hunter-gatherer to Food-producer*. Baker Press, London.
- Berardi, G.M. and Geisler, C.C. (Eds.). (1984). *The Social Consequences and Challenges of New Agricultural Technologies*. Westview Press, Boulder, Colorado.
- Berry, W. (1977). *The Unsettling of America : Culture and Agriculture*. The Sierra Club, San Francisco, California.
- Bezdicsek, D.F.; Power, J.F.; Keeney, D.F.; and Wright, M.J. (Eds) (1984). *Organic Farming : Current Technology and Its Role in a Sustainable Agriculture*. American Society of Agronomy, Madison, Wisconsin.
- Boserup, E. (1965). *The Conditions of Agricultural Growth*. Oldine Press, Chicago, Illinois.

Breimyer, H.F. (1980). The Economics of Organic Agriculture, Paper No. 1980-35, Dept. of Agric. Economics, University of Missouri, Columbia, Missouri.

Brown, L.R. (1981). Building a Sustainable Society. W.W. Norton and Co., New York.

Buttel, F.H., and Youngberg, I.G. (1983). Implications of Biotechnology for the Development of Sustainable Agricultural Systems. In Environmentally Sound Agriculture, W. Lockeretz (Ed), pp 377-400, Praeger Press, New York.

Clancy, K.L. (1986). The Role of Sustainable Agriculture in Improving the Safety and Quality of the Food Supply. Amer. J. Alternative Agriculture, 1: 11-18.

Cohen, M.N. (1977). The Food Crisis in Prehistory. Yale University Press, New Haven, Conn.

Conway, G.R. (1987). The Properties of Agroecosystems. Agricultural Systems 24: 95-117.

Council for Agricultural Science and Technology (CAST). (1980). Organic and Conventional Farming Compared. CAST Report No.84, Iowa State University, Ames, Iowa.

Crosson, P. and Brubaker, S. (1982). Resource and Environmental Effects of U.S. Agriculture. Resources for the Future, Washington, D.C.

Douglass, G.K. (1984). Agricultural Sustainability in a Changing World Order. Westview Press, Boulder, Colorado.

Edens, T.C.; Fridger, C.; and Batterfield, S.L. (Eds) (1985). Sustainable Agriculture and Integrated Farming Systems. Michigan State University Press, East Lansing, Michigan.

Farrell, K.R. (1984). The Sustainability of U.S. Agriculture : Economic Perspectives and Policy Issues. In Douglass (Ed) 1984.

Fields, G.S. (1980). Poverty, Inequality and Development, Cambridge University Press, Cambridge.

Georgescu-Roegen, N. (1971). The Entropy Law and the Economic Process. Harvard University Press, Cambridge.

Breimyer, H.F. (1980). The Economics of Organic Agriculture, Paper No. 1980-35, Dept. of Agric. Economics, University of Missouri, Columbia, Missouri.

Brown, L.R. (1981). Building a Sustainable Society. W.W. Norton and Co., New York.

Buttel, F.H., and Youngberg, I.G. (1983). Implications of Biotechnology for the Development of Sustainable Agricultural Systems. In Environmentally Sound Agriculture, W. Lockeretz (Ed), pp 377-400, Praeger Press, New York.

Clancy, K.L. (1986). The Role of Sustainable Agriculture in Improving the Safety and Quality of the Food Supply. Amer. J. Alternative Agriculture, 1: 11-18.

Cohen, M.N. (1977). The Food Crisis in Prehistory. Yale University Press, New Haven, Conn.

Conway, G.R. (1987). The Properties of Agroecosystems. Agricultural Systems 24: 95-117.

Council for Agricultural Science and Technology (CAST). (1980). Organic and Conventional Farming Compared. CAST Report No.84, Iowa State University, Ames, Iowa.

Crosson, P. and Brubaker, S. (1982). Resource and Environmental Effects of U.S. Agriculture. Resources for the Future, Washington, D.C.

Douglass, G.K. (1984). Agricultural Sustainability in a Changing World Order. Westview Press, Boulder, Colorado.

Edens, T.C.; Fridger, C.; and Batterfield, S.L. (Eds) (1985). Sustainable Agriculture and Integrated Farming Systems. Michigan State University Press, East Lansing, Michigan.

Farrell, K.R. (1984). The Sustainability of U.S. Agriculture : Economic Perspectives and Policy Issues. In Douglass (Ed) 1984.

Fields, G.S. (1980). Poverty, Inequality and Development, Cambridge University Press, Cambridge.

Georgescu-Roegen, N. (1971). The Entropy Law and the Economic Process. Harvard University Press, Cambridge.

Holling, C.S. (Ed) (1978). Adoptive Environmental Assessment and Management. Wiley and Sons, Chichester.

Just, R.; Schmitz, A.; and Zilberman, D. (1978). "The Social Impact of Technological Change in Agriculture," Technological Change, Farm Mechanization and Agricultural Employment, Div. of Agric. Science, University of California, Berkeley, No. 4085, pp 124-155.

King, F.H. (1927). Farmers of Forty Centuries. Cape, London.

Langley, J.A.; Heady, E.O.; and Olson, K.D. (1983). The Macro Implications of a Complete Transformation of U.S. Agricultural Production to Organic Farming. Agriculture, Ecosystems and Environment, 10(4): 323-333.

Learner, E.E. (1987). Sources of International Comparative Advantage : Theory and Evidence. Massachusetts Institute of Technology, Cambridge, Massachusetts.

Lockeretz, W.; Shearer, G.; and Kohl, D.H. (1981). Organic Farming in the Corn Belt. Science, 211: 540-547.

Lockeretz, W. (1983). Environmentally Sound Agriculture. Praeger Press, New York.

Lowrance, R.; Stinner, B.R.; and House, G.J. (1984). Agricultural Ecosystems : Unifying Concepts. Wiley and Sons, New York.

Maass, A. and Anderson, R.L. (1986). ... and the Desert Shall Rejoice : Conflict, Growth, and Justice in Arid Environments. Krieger Publishing, Malabar, Florida.

Madden, P. (1985). Regenerative Agriculture : Beyond Organic and Sustainable Food Production. Farm and Food System in Transition, Paper No. 33, Michigan State University, East Lansing, Michigan.

Madden, P. (1986). Beyond Conventional Economics. In New Directions for Agriculture and Agricultural Research : Neglected Dimensions and Emerging Alternatives, K. Dahlberg (Ed), Rowman and Littlefield, Totowa, New Jersey (forthcoming).

Norgaard, R.B. (1986a). Economic Theory, Natural Resources, and Inter-generational Equity. Paper presented at the Western Economics Association meetings in San Francisco, July 1. (Forthcoming).

Norgaard, R.B. (1986b). Can Science Inform Sustainable Development? : Problems in Social Organisation. Paper in preparation (Forthcoming).

Norgaard, R.B. (1984). Coevalutionary Development Potential. Land Economics. 60(2): 160-172.

Page, T. (1977). Conservation and Economic Efrficiency : An Approach to Materials Policy. The Johns Hopkins University Press, Baltimore, Maryland.

Papendick, R.I.; Elliott, L.F.; and Dahlgren, R.D. (1986). Environmental Consequences of Modern Production Agriculture : How Can Alternative Agriculture Address These Concerns? Amer. J. Alternative Agriculture, 1: 3-10.

Parr, J.F.; Papendick, R.I.; and Youngberg, I.G. (1983). Organic Farming in the United States : Principles and Perspectives. Agro-Ecosystems, 8: 183-201.

Phillips, R.E.; Blevins, R.L.; Thomas, G.W.; Frye, W.W.; and Phillips, S.H. (1980). No-Tillage Agriculture. Science, 208: 1108-1113.

Office of Technology Assessment (OTA). (1986). Technology, Public Policy, and the Changing Structure of American Agriculture. Government Printing Office, Washington, D.C.

Orians, G.H. (1975). Diversity, Stability, and Maturity in Natural Ecosystems. In Unifying Concepts in Ecology, van Dobben, W.H. and Lowe-McConnel, R.H. (Eds), Junk Publishing, The Hague, pp 64-65.

Rindos, D. (1984). The Origins of Agriculture : An Evolutionary Perspective. Academic Press, Orlando, Florida.

Rockefeller Foundation. (1982). Science for Agriculture. Rockefeller Foundation, New York City, New York.

Rodale, R. (1982). Breaking New Ground : The Search for a Sustainable Agriculture. The Futurist, 17(1): 15-20.

Ruttan, V.W. (1984). Induced Innovation and Agricultural Development. In Douglass (Ed) 1984.

Schuh, G.E. (1978). Approaches to Basic Needs and to Equity that Distort Incentives in Agriculture. In Distortions of Agricultural Incentives, T.W. Schultz (Ed), Indiana University Press, Bloomington, Indiana, pp.307-327.

Schultz, T.W. (1981). Investing in People. University of California Press, Berkeley, California.

Tansley, A.G. (1935). The Use and Abuse of Vegetational Concepts and Forms. Ecology, 16: 284-307.

University of California Committee (1986). Sustainability of California Agriculture: Proceedings of a Symposium, U.C. Sustainability of California Agriculture Research and Education Program, Davis, California.

USDA. (1980). Report and Recommendations on Organic Agriculture. U.S. Department of Agriculture, Government Printing Office, Washington, D.C.

Watt, K.E.F. (1986). Defining an Agricultural System. In Douglass (Ed) 1986.

Wittwer, S.H. (1983). The New Agriculture : A View of the Twenty-First Century. In Agriculture in the Twenty-First Century, J.W. Rosenblum (Ed), Wiley and Sons, New York, pp. 337-40.

Young, D.L.; Hoag, D.L.; Hinman, H.R.; and Horder, R.W. (1984). Yields and Profitability of Conservation Tillage in the Eastern Palouse, Report No. XB0941, Agric. Research Centre, Washington State University, Pullman, Washington.

ECONOMIC WEIGHTS FOR BREEDING OBJECTIVES

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Introduction

Animal breeders refer to measurable attributes of animals as traits and the subset of traits which they wish to improve as breeding objectives. The trick is to select objectives which are responsive to selection and which will contribute to greater profit.

In applying selection to a trait, breeders use the best estimate of an animal's breeding value from measurement of that trait in the animal itself and from measurements made on its relatives. Because there is often a genetic correlation between traits, measurements on correlated traits can be used to improve the estimate of an animal's breeding value for a related trait. Using statistical techniques best estimates are made of an animal's breeding value for each breeding objective.

The breeding values of each trait must be weighted by so-called economic values to calculate a selection index. This index combines the breeding values for each trait into a single dollar value (Cunningham 1969).

Hazel (1942), who first applied selection index theory to animals, defined the economic value of a trait as:

"... the amount by which net profit may be expected to increase for each unit improvement in a trait."

Because of the imperfections in the market for stud stock, animal breeders use a normative approach to estimate economic values for each trait. Partial budgeting is the preferred technique. For sheep, for instance, breeders estimate the extra profit resulting from a 100 gram gain in a ewe's fleece weight.

Recently, McArthur (1986) proposed a modification to Hazel's definition as:

"... the amount by which net profit of the optimal policy may be expected to increase for a unit improvement in that trait."

Two examples will help explain the reason for the modification. Suppose a pair of economic weights are required for a selection index for sheep - one for wool weight and the other for Number of Lambs Born. For NLB, the optimal policy with low fertility sheep may be 'easy care' management at lambing time. The optimal policy for high fertility may be to employ labour for shepherding at lambing. The optimal management systems along with their associated costs should be used when comparing profits from a change from low NLB ewes to high NLB ewes.

The trait of disease resistance in egg producing chickens provides another example. Before the improvement in disease resistance, the optimal policy may be to replace birds yearly. After selection for disease resistance, biennial replacement may be more profitable. The gain in profit from selection is the net profit from improved disease-resistant birds replaced using the optimal biennial policy minus the net profit from the unimproved disease-susceptible birds replaced using the optimal annual replacement policy.

I have found some reluctance amongst animal scientists to accept the idea of counting a gain as due to breeding which comes from a change in management policy. However, economists believe that producers tend to be profit maximisers and that they would shift to a biennial replacement policy if they had disease-resistant chickens. Their response to genetic improvement as well as the response in the birds should, I believe, be counted in the gain in profit.

A Systems Approach for Calculating Economic Values

Following the definition of economic value of a unit change in a trait, this section describes a general systems approach for finding them.

Let π_0^* be the initial net benefit before the trait is changed. This may be annual profit if the analysis is at the farm level. At the national level for the farming system it will be benefit less cost using some appropriate numeraire. Judgement is required as to where to put the system boundaries.

$$\pi_0^* = f(D_0^*, A, T) \quad (1)$$

where: D_0^* is a vector of optimal decision variables before improvement. A is a vector of parameters including prices, input-output coefficients, and technical constraints which are held constant. T is a vector of trait variables set at existing average levels. π_0^* is optimal profit resulting from applying the vector of optimal decisions.

For the i^{th} trait the t -value in vector T is increased by a appropriate amount Δt_i . A new vector of optimal decisions D_i^* is found which results in the maximum net benefit π_i^* . The economic value for the i^{th} trait, v_i is

$$v_i = (\pi_i^* - \pi_0^*) / \Delta t_i \quad (2)$$

These v - values can be expressed per animal by dividing through by the number of animals or be simply expressed as relative economic values.

Any one of a number of optimising methods could be used to find the best set of decision variables ranging from simple partial budgeting, through differential calculus and mathematical programming to simulation.

This systems approach to deriving economic weights for various traits can be applied when this is the last operation in designing a programme for animal improvement. Usually a large data set has been collected for various traits on a population of animals. From this data set the technical statistical parameters are derived to construct a selection index. The last step is to estimate the economic weight for each objective.

However, the systems approach should really be applied at the outset as a method of looking for breeding objectives - perhaps by looking for marketing opportunities. As an imaginary example, systems research might reveal that a subset of the human population are allergic to allergens in milk which can be selected against. A systems analysis would attempt to estimate the price of such allergen-free milk and to find the relative weights which should be placed on this and other breeding objectives.

Economic Values by Rescaling

Recently Smith, James and Brascamp (1986) have published a method of deriving economic weights which result in relative economic weights which are the same for various perspectives - per unit of product, per animal, and per producer. In order to achieve this uniformity they suggest the imposition of two conditions.

The first condition eliminates the need to distinguish between variable and fixed costs by estimating the impact of genetic change in the context of long-run decisions where all costs are variable. They justify this approach on the ground that breeding gives long-run gains which is logical.

However, economists usually assume that in the long-run producers face diseconomies of scale with rising long-run marginal costs. They also assume that in the long-run producers are profit maximisers and equate the long-run marginal cost with the product price at which point producers are operating at the most profitable scale.

The second condition imposed by Smith et al. is that any extra profit from genetic change that could also be obtained by altering the size or rescaling the operation should not be counted in assessing the value of genetic improvement. This, they claim, is because a producer can change profit without genetic improvement simply by rescaling his production enterprise. They do not provide the economic rationale for not counting these scale effects.

An example from a dairy farm will explain the application of their second condition.

Suppose selection increases milk fat production per cow by 1 kilogram and that farm profit rises by say \$800 because of total product rising by 200 kilograms. By Hazel's definition the economic value would be \$800. Smith et al. say that the scale of operation has been increased by 200 kg. They say that this effect must be removed. A 200 kg increase in total product could be achieved with unimproved cows by "extending the boundaries of the farm" sufficiently to produce an extra 200 kg. Such an adjustment to the farm's scale might increase profit by say \$300. Subtracting this from the \$800 leaves \$500 which is the true economic value.

There are two difficulties with the Smith et al. method.

1. Under the assumption of profit maximisation and eventual diseconomies of scale, producers simply cannot increase profit by rescaling the size of their enterprises because they would already be at the optimum scale where price equals long-run marginal cost. Extending the boundaries of the farm to match the increase in production using unimproved cows would yield a zero gain in profit. Subtracting the effect of rescaling would leave the value of \$800 untouched.

The examples given by Smith et al. use linear long-run production functions which ignore the possibility of eventual diseconomies of scale. Production per cow would be the same for the cow walking 2.5 km a day to and from pasture in a herd of 300 as for the cow walking 8 km daily to pasture in a herd of 3000. Under these conditions it is always possible to increase profit by increasing the scale of the operation. This leads to the consideration of the second difficulty.

2. This concerns the economic justification for extracting the effect of scale from the economic value calculated in the usual way. Production decisions concerning a proposed course of action often result in increases in output. Such courses of action should be adopted if the value of the extra output exceeds the costs of the extra inputs where costs include opportunity costs. To subtract net benefits from expanding the scale of the enterprise could result in suboptimal decisions. When non-zero effects of rescaling are removed from economic weights as conventionally calculated they do not measure change in profit.

Some Examples

Some examples will amplify both the modification of Hazel's definition and the rescaling procedure.

Suppose that production per cow of milk fat (AP) falls as the scale of a dairying operation increases. The scale here is measured by the number of cows being put through one shed. x is the number of cows in

$$AP = a + bx \quad (3)$$

where a is positive and b is negative, and total product TP is

$$TP = ax + bx^2 \quad (4)$$

resulting in total revenue TR of

$$TR = p (ax + bx^2) \quad (5)$$

where p is the price per unit of milkfat.

Cost per cow c is a constant and total cost is cx resulting in a profit equation of

$$\pi = (pa - c)x + pbx^2 \quad (6)$$

The profit maximising scale of operation in terms of number of cows is where $d\pi/dx = 0$. The optimum scale x^* is

$$x^* = (c - pa)/2pb \quad (7)$$

If production per cow in equation 3 increases by one unit as the result of selection a shifts to $a + 1$. The consequent increase in profit is px^* . The economic value of a unit change in milk fat per cow E_1 is

$$E_1 = (c - pa)/2b \quad (8)$$

or simply p dollars per cow.

Because of a unit shift in production per cow total product has shifted by x^* . Smith et al. insist on correcting E_1 for this change in scale and require that the extra profit from increasing the total product by x^* through the use of more unimproved cows. Unimproved cows produce $a + bx^*$ per cow so that $x^*/(a + bx^*)$ of them would be required to raise total product by x^* . Extra profit would be $(x^*/(a + bx^*))d\pi/dx^*$. Subtracting this term from E_1 to find an economic weight as calculated by Smith et al. leaves E_1 unchanged because $d\pi/dx^*$ is zero.

The second condition imposed by them does not alter the economic value when the profit maximizer faces diminishing returns. The Smith et al. economic value E_2 is

$$\begin{aligned} E_2 &= E_1 - (x/(a + bx))d\pi/dx \\ &= \frac{cx - pbx^2}{a + bx} \end{aligned} \quad (9)$$

A unit shift in production per cow would in theory result in reassessment of the optimal scale. The optimal size of the operation, as given by equation 7, would shift from $(c - pa)/2pb$ to $(c - p(a + 1))/2pb$. By this author's definition, the economic weight E_3 is

$$E_3 = \frac{c - pa}{2b} + \frac{-p}{4b} \quad (10)$$

The extra term is an addition due to the shift to the new optimal scale of operation and represents the optimising management change appropriate for running better cows.

Smith et al. use as an example a linear production function without any falloff in output per animal as the size of the enterprise grows.

$$AP = a \quad (11)$$

$$TP = ax \quad (12)$$

$$\pi = (pa - c)x \quad (13)$$

This profit equation has no optimum. Profit can always be increased by increasing the scale of operation. If production per cow is increased by one unit through selection, a increases to $a + 1$ and profit π_1 is

$$\pi_1 = (p(a + 1) - c) x \quad (14)$$

The economic weight by Hazel's definition E_4 is

$$E_4 = \pi_1 - \pi = px \quad (15)$$

or p dollars per cow

However, total product will now be $x(a + 1)$. This total product could alternatively be produced with unimproved cows producing only a if the enterprise was rescaled so that it runs $x(a + 1)/a$ cows. This rescaling is possible because AP is not affected by the scale of operation.

The profit equation for the rescaled enterprise is

$$\pi_2 = (pa - c) x(a + 1)/a \quad (16)$$

Smith et al. claim that this is the base from which to measure increased profit.

Change in profit from a unit increase in a for them E_5 is

$$E_5 = \pi_1 - \pi_2 = cx/a \quad (17)$$

which is c/a per cow.

This result makes the economic weight a function of cost and excludes the price of the product. cx/a measures the reduced costs of producing a fixed level of output as shown below.

Suppose that output is fixed at Q because of a quota so that the scale of the enterprise is fixed at Q/a cows. The profit equation is

$$\pi = (pa - c) Q/a \quad (18)$$

and the reduced cost of producing Q , E_6 is

$$E_6 = d\pi/da = cQ/a^2 = cx/a \quad (19)$$

Smith et al. are aware that their rescaling procedure can eliminate product price from economic values and write "Thus the economic value of genetic improvement comes from reducing costs per unit of product value, rather than changing output (or output value)".

Discussion

The method of rescaling advocated by Smith et al. measures a different aspect of economic gain depending on the form of the production function used. If the model assumes profit maximisation and diseconomies of scale their economic value simply measures the usual gain in profit from a unit change in a trait because the correction for rescaling is zero. If the model assumes a linear production function their method measures reduced cost of producing a fixed quantity of output. In this instance, prices of output can be ignored. Some animal breeders see this as an advantage because output prices are unstable and are subject to a great deal of uncertainty in the long-run. Moreover, in Europe, output is constrained by quotas for some forms of animal production and the objective of minimising costs of production may be seen as the true objective. However, if this were the global objective, it would seem more appropriate to measure this directly rather than confuse the issue by using a rescaling procedure whose effect depends on the underlying production function behind the profit equation.

For the selection of multi-purpose animals estimating the gain in profit from a unit gain in a trait when following the optimal policy seems a much more general framework for finding economic values. Such values do not ignore the price of the product and hence the willingness of the consumer to pay. To ignore product prices seems a serious omission.

Product prices are essential for economic weights for multi-purpose animals such as the sheep. Here breeding objectives include wool and meat whose relative economic importance cannot be measured without the use of prices of these two products.

Finally, the identification of breeding objectives and their economic valuation through a systems approach is likely to result in a more innovated and market-led approach to making best use of animal breeding technology.

References

- Cunningham, E.P. (1969) Animal Breeding Theory, Landbruksbokhandelen Universitetsforlaget, Oslo.
- Hazel, L.N. (1943) The Genetic Basis of Constructing Selection Indexes, Genetics 28:476-490.
- McArthur, A.T.G. (1987) Weighting Breeding Objectives - An Economic Approach, Australian Association of Animal Breeding and Genetics. Proceedings 6th Conference, Perth p 179-187.
- Smith, C.; James, J.W. and Brascamp, E.W. (1986) On the Derivation of Economic Weights in Livestock Improvement, Anim. Prod. 43:545-551.

THE ROLE OF ADVISORY SERVICES IN AN
AGRICULTURAL MARKETING STRATEGY

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SUMMARY

Marketing in the classical sense requires producers to anticipate and match consumers' needs and wants. At the farm-gate-level, it is obvious that agricultural industries are not organised to meet this requirement. This is not a problem as long as farmers can make their decisions within a framework of guaranteed prices as in the case of the EEC. It will almost certainly become a problem when individual farmers have to make their decisions in a deregulated environment as is envisaged in New Zealand. This paper endeavours to examine why farmers have little scope in their production decisions, and what kind of strategies will be applicable under these conditions.

Key Words: Farm Diversification, Product Development,
Food Marketing, Advisory Services

INTRODUCTION

Agricultural marketing strategies, as indicated by the title, can be seen in two different ways:

- a) General strategies, which are based on universal characteristics, as they apply to any agricultural industry in the world;
- b) specific strategies, which are tailor-made to the situation of New Zealand in 1987.

Personally speaking, I have two good reasons to prefer the former version. First of all it should be borne in mind, that the adoption of market led farming is so complex a procedure, that answers should be based on the speaker's full body of knowledge. Now I have honestly to admit, that most of my knowledge was acquired prior to my arrival in New Zealand, which lends itself to a universal approach. The second reason is probably even more relevant: the farming community is not a homogeneous unit. Depending on physical conditions, the nature of a given product, and the attitude of individual farmers, different segments emerge, which require a number of parallel strategies. Thus it seems unlikely that none of the following recommendations apply to New Zealand. Yet it may well be the case that segments differ in their size and importance, and that corresponding strategies will have to be located on different levels of priorities. I would be happy to leave this latter point open to further discussion.

A GLOBAL VIEW

Even the most superficial observer of agricultural commodity markets cannot escape the impression of huge gluts and surpluses of unsaleable produce. It is true that during the past ten years, world food production has grown by nearly 30%, as compared with an increase of population by some 20%. This does not deny the fact that millions of people in the Third World suffer from hunger. Problems in the Third World, however, have much to do with the lack of purchasing power - a point which cannot be pursued here for obvious reasons. It is probably a less known fact that on a global scale, 49% of all dairy products; 46% of all meat products; 37% of all fruits; 34% of all cereals; and 32% of all sugar are produced in industrialised countries, whose share of world population is only 18% (Suhler, 1983). Hence the onus is transferred back to those countries where purchasing power is not an argument. In these parts of the world in turn, forces are at work which may potentially aggravate the problem. The enormous growth of international trade, for example, has lead to an

abundance of products on the market place, which makes consumers more discerning in regard to taste, quality, price, and product appeal. As fewer food retailers control an increasingly large proportion of the market, and own-brand products account for an increasing share of each retailer's offering, the "product" is becoming the store and the "brand" is the corporate identity by which the store is identified (Sewell, 1986). In such an environment, only suppliers who offer the best possible quality at the lowest possible price can survive. Now, of course, it would be unfair to say that agricultural industries - or at least their key persons - are unaware of the necessity to steer production in accordance with market realities. Several approaches in several parts of the world may serve as an illustration to outline the opportunities, and perhaps even more, the limitations of such an undertaking.

Any visitor in a country belonging to the COMECON (Council for Mutual Economic Aid) will be in a position to study the most radical, and perhaps even the most consequent, approach of agricultural planning. Since communists however, stubbornly refuse the recognition of market forces, their approach has fallen into discredit a long time ago. Even though their attitude towards marketing is slowly going to change, other drawbacks remain in place. Thus a central organisation is normally not in a position to judge carefully about the suitability of a specific area for a specific type of production. The attempt to extend wheat farming into extremely arid areas during the late 1960's, as part of the so-called "new-land-scheme" in Kazakhstan, was probably the most conspicuous failure of Soviet agriculture.

Farming subsidies in the EC (European Community), the U.S.A. and Japan totalled approximately \$NZ130 billion in 1985, of which the EC alone spent \$NZ30 billion. (1) Justification of these subsidies is overlaid by numerous arguments applying to the domestic political situation in those countries, rather than to academic thinking. The major rationale originally was that subsidies should provide a buffer against price fluctuations, which occur almost inevitably in commodity markets. It is interesting to see where such fluctuations originate from. If the price of a given commodity is at some time above or below the average market price, the

(1) Computed on the base of \$NZ1 = 1.50DM from:
"Folly of food politics: surplus in that country,
starvation in this one" (The German Tribune,
No. 1239).

producers expect that this situation will continue, and even then when they change their supply under otherwise equal conditions. At this price, which is already above the equilibrium price, they begin a production process larger than the equilibrium quantity. If this amount is brought to the market at the close of the production period, the price drops below the equilibrium price *ceteris paribus*. At this point the producers - again thinking that the price will remain the same - start a production process which lies below the equilibrium quantity. If this quantity is brought to the market, the price will increase above the equilibrium price. We now arrive at the original situation and the circle is completed; the entire procedure can start again (Plate & Bockenhoff, 1984). Now it is easy to see what happens in the case of subsidies: below average prices, and consequently periods of contraction, are eliminated by definition. The circle does not close any more. Farmers see little reason why they should limit their production. Instead, they will sooner or later discover that prices are made by political bargaining. A new development starts: surpluses are piling up which in turn are used as an argument to call for even more protection. The outcome of this development is well illustrated by one of the most recent press releases:

"Agricultural spending is growing out of control, and there will be a budget deficit this year of about \$NZ12,000 million. So far the community has found no way of controlling the first, or avoiding the second. Last week farm ministers were engaged in a marathon session to try to fix farm prices, but the longer they go on talking the bigger the problems become."(2)

Subsidies in the Third World are ruled out by various reasons, amongst which insufficient government revenues, and the need to keep food prices low, are the most important. LDC's (Less Developed Countries) hope instead to combat hunger with the help of the "green revolution", which implies the use of modern inputs, such as machinery, chemical fertilizer, pesticides and so forth. Farmers in those countries depend accordingly on credit schemes as offered by international corporations in the way of contract farming, by Foreign Aid organisations of various nations, and, last but not least, by such reputed bodies as the World Bank and the FAO. Credit schemes normally

(2) "Budgetary blues again in EEC", Otago Daily Times, 25 June, 1987.

require supervision by experts, and these experts in turn find there unique opportunities to test their academic theories in a real-world situation. Insofar as it is not without benefit to study approaches of market-led farming in the Third World, in many cases the results of these experiments do not live up to expectations. In most of these cases it seems difficult or impossible to come to grips with the following three handicaps:

- a) Lack of accurate information regarding the global development of demand;
- b) lack of management skills as required for the establishment of new marketing organisations; and
- c) lack of enthusiasm on the part of the local farmers involved.

New Zealand needs to be seen differently again. Here, there is no such thing as subsidies or planning approaches. Instead, New Zealand's economy depends a good deal on world market commodity prices. Deregulation means that the full impact of price fluctuations will be passed on to individual farmers. Put it another way; farmers who are either not willing or not able to adapt to market conditions will be bearing the brunt of deregulation. At this point now, it is worthwhile to remember the two basic challenges in market-led farming: knowledge of demand, and appreciation of it on the part of the farmers. This requires an organisation, which on one end of the pipeline possesses sufficient skills and resources to maintain and operate a global intelligence network - and - which has staff on the other end of the pipeline who are familiar enough with the needs and aspirations of individual farmers to be capable of either convincing them to change production into a more profitable direction, or - and this may happen as well - to convince their superiors that there is no room for changes at all. Apart from agricultural advisory services it would be hard to find any other organisation being in a position to match both of these objectives.

DECISION MAKING ON A FARM-GATE LEVEL

Physical restraints

Marketing advocates anticipating and matching consumers' needs and wants, which is normally seen as a task of the manufacturer or producer. Now it must be recognised that farmers used to have quite different criteria in mind when planning their production. Squire & Delahunty (1982) outline seven different constraints which eventually guide decision making on farms. These are:

- a) Land (area, climate, soils, off-farm facilities);
- b) livestock (breed, stock reconciliation);
- c) crop (cultivars, yields);
- d) trading (access to outlets);
- e) cash (expenditures, revenues);
- f) labour (time, skills);
- g) personal (abilities, enthusiasm).

It needs no explanation to realise that farmers are much more familiar with the above-mentioned requirements than with the wants of consumers, who probably live in some remote part of the world. Ironically, it is just the high level of competition in food marketing that forces farmers even more to give priority to physical restraints. Thus it is not enough to say that the land is somehow suited for the growth of a certain crop - the land must be perfectly suited in order to achieve maximum quality at reasonable cost. Skills gain importance, since farming requires an increasing number of jobs, which cannot be done well without prior vocational training. Cash may be a severe restraint in cases where standards in demand can only be maintained with the help of modern technology.

Even when observing these restraints in a rigid sense, there are comparatively few cases where farming is confined to one single product only. Most of such examples are found in marginal areas where farming is a questionable exercise anyhow. In all other areas, the above-mentioned restraints just provide a framework within which a farmer may have something between 2 and 20 different options. This leads to some relevant questions:

- a) How many options are available for decision-making?
- b) What factors define the frequency of these decisions?
- c) What are the considerations underlying these decisions?

In the case of New Zealand it would be very desirable to find answers to these questions first, before entering into details of strategic planning. In the meantime, however, it is of value to outline some fundamentals of agricultural marketing strategies in order to see what tasks are involved, and what benefits can be expected.

The time lag

It takes 4-5 years for a kiwifruit vine to start bearing worthwhile crops, and about 8-9 years for it to reach full bearing (Sale, 1983). Regarding the lifespan of an orchard, little documentation is available, yet it might be realistic to assume 50 years. Adding to this an initial investment in the order of half a million NZ\$, it becomes clear that any grower once voting for kiwifruit will be reluctant to change his production in favour of short-term demand fluctuation. In the livestock area the situation is slightly more complicated. It is true that lamb has a production period of just a year. Yet if one takes into account that a certain amount of breeding stock has to be maintained, and if one considers the difficulties of turning grassland into crops, then it becomes obvious that the planning period must be a multiple of that year. In dairy farming, several calculations show the useful life of a cow in the range of 7 to 9 years. Little wonder that price fluctuations in world dairy markets follow that rhythm. The shortest production period applies for vegetable growers. Unfortunately, the vegetable market is very volatile and hence subject to unforeseeable price movements.

The case of Turkish horticulture

In the framework of a PhD Thesis on the horticultural industry in Turkey, I had the opportunity to conduct interviews with a total of 124 growers. Realising that, given the above-mentioned conditions, it must be extremely difficult to make any sensible product decision at all, I included the following two questions: (Negendank, 1986)

- a) Between sowing or planting and the final sale there is a time lag of several months (in the case of trees even several years). Theoretically, you have to take count of future demand already when you decide on your production. How do you solve this problem?

In reaction, 9% of the growers said that they approach the agricultural advisory service in such question; 23% endeavoured to make their own forecast; but a remaining majority of 68% could not see any solution at all.

- b) On what considerations do you actually base your decision then?

In reply, 22% claimed to use their own forecast as a yardstick; 43% put natural ecological conditions to the fore; but a strong minority of 35% stated again, that in fact they had no idea on how to make a decision. One farmer compared horticultural production with a lottery game.

These results have several serious implications. If one accepts that, say, horticulture is some type of gambling, then this would be in conflict with a number of current economic theories. Thus the idea of free competition is generally justified by the assumption that it weeds out inefficient enterprises with the result that only the most efficient ones stay in business. Now in an environment of extreme uncertainty, only those businesses will survive which are lucky enough to make the right forecast. This might be desirable, if it is assumed that such forecasts rely on any type of skill or academic knowledge. Yet this is a very questionable assumption. On the other hand, it is interesting to see that at least 9% of those growers approach the agricultural advisory service. On further questioning, these growers indicated indeed that they recognise both factors: the necessity of having a forecast, and the impossibility of doing it on their own. The advisory service would probably have been more popular if it had had better access to reliable data sources. Unfortunately this does not yet apply for a country like Turkey.

The planning approach

Prima facie it would be logical to conclude that decisions have to be made by an outside organisation, if farmers are not in a position to do it on their own. In general, such approaches are associated with a somewhat "communist" smack, which totally overlooks that big land corporations practising farming on a contract basis, do basically the same. The position of a contract farmer is not too different from his eastern counterpart working in some government-controlled co-operative. In both cases the farmer would not be entitled to make any decisions on his own. There are differences, however: A land corporation takes demand well into account, and it normally controls only part of the industry instead of the whole. That makes it less conspicuous and more successful. Yet there is one problem difficult to solve: How to assess and control the potential of a given plot of land from central headquarters? In many countries, where advisory services are not necessarily forthcoming to support private interests, such a corporation will be forced to employ its own staff of experts. This in turn is a cost factor which needs to be outweighed by additional profits. This may be the case when control over supply provides some specific advantage. In buyers' markets, however, where high quality, low price agricultural produce is abundant, this advantage is not particularly strong. The corporation is then left with the option of either withdrawing from production and confining itself to mere trade functions - as in several parts of Europe - or virtually to exploit contract farmers - as in several parts of the Third World. The latter, quite naturally, makes contract schemes extremely unpopular among farmers.

The other extreme is to recognise commercial farms as businesses, where the owner/operator is the ultimate decision maker. Guidance would be only given on request, normally at the end of a production period when the farmer has to decide whether he wants to renew previous production, i.e., by purchasing the same type of stock (or seeds or seedlings) again, or whether he wants to venture into new areas. At least at this point, farmers are normally eager to use forecasts providing them with some clue in regard to the possible outcome of either direction. The challenge here lies with the fact that farmers who actually ask for a forecast normally rely on the superior knowledge of the organisation which provides such advice. In theory, the farmer ought to be free either to accept or to reject the data given by the forecast. In practice, many a farmer may be inclined to rely blindly on the data, and consequently blame the advisor when the outcome does not meet expectation.

Before entering into this controversial issue, I would like to draw your attention to some other strategies which might be more palatable from a political point of view.

AGRICULTURAL MARKETING STRATEGIES

Core demand strategy

Marketing consultants quite naturally focus on points, where their clients arrive at a road fork. In the case of farmers, this applies to the time when the lifespan of one production cycle has expired, and some decision has to be made about the next cycle to come. Superficially, this gives way to the impression that marketeers would be advocates of change. In agriculture this is not appropriate. If someone argues that farmers used to be conservative, then it should be borne in mind that consumers also used to be conservative. This is particularly true in regard to foodstuff, and in particular when the total globe is considered as a market. Even though markets of butter, lamb, beef or wheat provide headaches for many an expert, it is obvious that consumers were less than happy, if such well known products suddenly disappeared from the market. Surpluses refer only to a certain percentage of production - often less than 50%. In this case, only a minority of farmers would have to change production; probably those who are on the outlook for new areas anyhow. The remaining majority will be fairly safe in their traditional area. The challenge now is to discern between both groups.

Based on similar considerations, the EC recently introduced quota regulations for milk. Yet politicians also perceived farmers as an electorate, and hence allocated quotas in such a generous manner that any effect on the market place will be close to zero. A more consequent approach was adopted in Switzerland about ten years ago. On the grounds that high country farmers have little or no production alternative, preference was given to dairy farms located 1,000m or more above sea level. Exceptions from this contour line were admitted, if required by topography. According to an executive of Swiss advisory services, law courts were kept busy with sorting out these exceptions at least for a couple of years. The O.C.E. (Office de Commercialisation et d'Exportation) in Morocco operates as some kind of marketing board for tomatoes, a product generating some 13% of the country's income. The O.C.E. keeps close contact with major horticultural importers, and hence is in a position to forecast expected demand before the growing season starts. According to these forecasts, export quotas

are allocated. Moroccan farmers, however, complain about "abnormal percentages" of non-exportable produce (Hormann, 1979).

The administrative problem of these approaches lies with the fact that quota-regulations were exerted on a nation-wide basis. The alternative is defining small areas of specific micro-climate and soil conditions, where product output is distinguished enough to justify a separate brand. Such justification is given, for instance, when local growing conditions have a marked impact on flavour and taste, and when at least some segment of the market shows preference for the resulting flavour. This branding approach has several advantages. Distinguished brands are likely to be accepted in those segments where the corresponding product ranks high in the preference scale. Branded products thus attract the most loyal ones among potential consumers; an effect which is inclined to create some stability in otherwise volatile markets. In many cases, the better flavour may justify premium prices, and hence improve incomes of the farmers involved. Taken all together, access to such brand must be seen as a privilege, which in turn gives much power to any organisation which has legal rights on this brand. Normally this power will be used to impose various rules and regulations, designed to improve performance of those farmers who have joined the corresponding scheme. Improved performance, of course, adds a second quality factor on top of the given natural advantages, and thus enhances the brand-profile. Given such circumstances, farmers are likely to face additional challenges in the way of skills and workload required. The reward consists of higher prices and a fairly safe market.

The paramount organisation, which owns the brand, will be a producer co-operative in such cases where farmers discover natural advantages within a given area, and hence decide to organise themselves under a common brand. Evidence of natural advantages may be derived either from historic reputation - as is frequently the case in Europe, - or it may be the result of contemporary agricultural research. In cases where farmers are not aware of their advantages, initiative may come from a food manufacturer who is on the lookout for specific types of supply. Provided that such manufacturer offers long-term delivery contracts at a premium price, there will be a similar outcome as described above. Here again, the manufacturer who possesses a premium brand will be in a strong position to impose various quality regulations. Examples of both directions, i.e., initiatives from co-operatives or from manufacturers, can be found in Europe typically in markets such as wine, horticultural products, and dairy

products where cheese needs to be mentioned in particular. In regard to these products, there is a general appreciation that taste qualities stand in relation to environmental factors. Many of the corresponding production areas enjoy longstanding reputations in respect to a specific product or brand. In New Zealand, where historic reputations have had less time to develop, it seems paramount to devote more research into the relationship between growing conditions and the taste of a product, in order to identify regions which lend themselves to the development of profitable brands.

A special case is the market of organic food products in Central Europe. Even in 1979 the market of health food in the Federal Republic of Germany had a volume of, then, 2 billion DM (Weindlmaier, 1982). Taking into account the subsequent growth of this market as well as the development of exchange rates, a translation into 2 billion NZ\$ might probably be an understatement. Since health food consumers are particularly anxious about the purity of their food, organic products were marketed through separate channels from the early beginning. In order to maintain sufficient control over these channels, strong brands developed, for instance, BIOLAND and DEMETER. The corresponding organisations are now seeking contact with New Zealand - obviously because their customers do not wish to renounce from off-season products.

Product Diversification

A good introduction into this concept is given by David Yerex (Yerex, 1980). Historically, diversification was a risk-avoiding strategy, where a single farm endeavoured to grow a maximum of different products in the hope that - independent of the actual market - at least some of them will fetch acceptable prices in a given year. This attitude is still prevailing among mediterranean fruit growers who face enormous problems in finding any reliable forecast to guide their long-term investment decisions. Diversification taken in this sense logically denies the goal of profit maximisation: If, say, 10 out of 20 different tree crops are profitable in a given year, then the other half of production must be non-profitable.

Risk minimization in this sense applies to New Zealand only on a nationwide basis. Individual producers may well address their major thrust to a single speciality such as opossum, feijoa, or salmon. In doing this, the farmer as an individual may find himself in an extremely volatile market. The point is that even small changes in production may be strong enough to upset a market which has a narrow base of demand. Due to a lack of

relevant data concerning New Zealand's specialities, I have to use the marketing of mangoes in France as an illustration. Total demand in 1986 was 6,000mt, whereas supply came from 33 different provenances, which means an average of less than 200mt per supplier (3). Apart from the question of whether a comparatively small market should be shared by that many competitors; It is remarkable to see countries like Brazil in this context, which has such a huge agricultural potential that the figure of 6,000mt of mangoes would probably not even appear in her national statistics. In such cases, very thorough methods of investigation are required, because events which seem to be insignificant in one country, may have a disproportionate impact in another place. Fortunately it may be easier to monitor a small market, in particular if the business is concentrated in a few hands, and if it is possible to establish and maintain good relations with the relevant businesses. This procedure will be facilitated in case corresponding businesses are interested themselves in a global monitoring approach.

Processing

Following the current way of discussion, It sometimes appears that processing of agricultural products is slightly confused with the "value added" concept. In the first instance, at least, processing adds costs to a product. The question of whether or not these costs materialise in added value, must be answered by the ultimate consumer. Ironically, there are cases where processed products are sold more cheaply than their fresh counterparts. A case in point is canned fruit and vegetables, which appear inexpensive because:

- a) Processing makes use of second grade produce, whereas the fresh market accepts only first grade quality. There may be a considerable difference in price between both qualities.
- b) Canning relies on a well established technology, which can be handled in L.D.C.'s who have the advantage of cheap labour.
- c) Canning of horticultural products benefits from heavy subsidies in the Common Market.

(3) fel actualites, Import 1986, May 1987.

Fortunately, processing incorporates many more options. According to the chairman of the German Food Manufacturers Association, in 1982 along 900 new food products were registered in the F.R. Germany (Oetker, 1983). This reflects a current trend towards more individualistic attitudes in regard to processed foodstuff. In consequence, a marketer should reckon with a large number of comparatively small niches rather than with some big homogeneous market. Generalisations are not possible. Research needs to be done on a case by case approach.

THE ROLE OF AGRICULTURAL ADVISORY SERVICES

Planning and implementing successful marketing strategies in an agricultural industry is virtually an art of keeping the right balance between two different poles. One of these poles is current potential and future development of demand regarding a given product in a given marketplace. The other pole comprises production opportunities and enthusiasm of individual farmers. History has shown that strategies inevitably fail when this balance is lost, i.e., when too much stress is laid on one extreme at the expense of other requirements. According to its self-understanding as an organisation, any agricultural advisory service seems to be the most suitable body to maintain this balance. Yet the magnitude of the job must not be underestimated. New Zealand faces a situation where - in the absence of reverse evidence - every nation of the world might be a potential market. On top of that, every conceivable strategy involves decision-making with long term implications. Forecasting becomes a must. Even if one assumes that skills and expertise are there, then corresponding research might still cause expenditures which are impossible to meet in the current situation. Co-operation might be an answer. Numerous data-banks, intelligence services, research institutes and trade associations exist in many parts of the world who possess a wealth of relevant knowledge. In many cases, it pays to keep in close contact with Importers who have sufficient experience in the corresponding business. As far as New Zealand is concerned, marketing boards and authorities, private consultants, and sometimes even universities, may be able to make their contributions. The challenge now consists in orchestrating these contributions in a way that provides maximum efficiency of research. The prerequisite consists, of course, in an accurate assessment of the flexibility or inflexibility of New Zealand's agricultural industry. Relevant questions are:

- What percentage of a given production cannot be changed in the near future?
- What cases exist where regional brands are applicable?
- Where is it possible to find low priced, second grade produce in order to supply processing businesses?
- What percentage of farmers is prepared to diversify, and in what direction?

The subsequent discussion alone of these questions might be a step in the right direction.

Thank you for your attention.

REFERENCES

- Hormann, D. (1979). Absatzkoordination beim Export von Frischgemüse, Insbesondere von Afrika nach Europa. In: Vermarktung von Agrarprodukten in Entwicklungslandern, DAF (ed.), pp 138-160, Munich.
- Negendank, O. (1986). Wege zur Effizienzverbesserung der Obst-und Gemusevermarktung in der Präfektur Icel (Turkei), p. 167. M + M Wiss., Krefeld.
- Oetker, A. (1983). Die bedeutung der Ernährungs-industrie für die deutsche Landwirtschaft. In: Agrarmärkte & Agrarmarketing, bbv (ed.), pp 45-51, Behr's Hamburg.
- Plate, R. and Bockenhoff, E. (1984). The Fundamentals of Agricultural Market Policy. Unpubl. translation by T.P. Young (German original, BLV Munich), pp 116-120.
- Sale, P.R. (1983). Kiwifruit Culture, p.69. Govt. Printer, Wellington.
- Sewell, M. (1986). Effective Merchandising in a Food Environment. Food Marketing, Vol.2, No.1, pp 55-60.
- Squire, J. and Delahunty, E. (1982). Farm Business Management, pp 39-58. Longman Paul, Auckland.
- Suhler, G. (1983). Die bedeutung des Agrarexports für die deutsche Landwirtschaft. In: Agrarmärkte & Agrarmarketing, bbv.(ed.), pp 189-194, Behr's, Hamburg.
- Weindlmaier, H. (1982). Tendenzen der Lebensmittel-nachfrage und Konsequenzen für das Lebensmittel-marketing. Conference Paper, GeWiSoLa 23rd conference 29 September-1 October 1982, Giessen.
- Yerex, D. (1980). Farm Diversification. D.F. Jones, Wellington.