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**THE ROLE OF RURAL LAND IN MIXED ASSET
INVESTMENT PORTFOLIOS**

CHRIS EVES*
University of Western Sydney, Australia

* Contact Details

School of Construction, Property & Planning
Locked Bag 1797, Penrith South, DC 1797, Australia
Phone: 61-2-98524219
Fax: 61-2-98524185
Email: a.eves@uws.edu.au

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9.1 Introduction

Rural land has not always been considered as a major long-term investment with both institutional investors and absentee owners in countries such as U.K. and Australia. Although rural land is included in both single asset and mixed asset portfolios in the U.S, it is not at the same levels as either commercial or industrial property.

Rural land occupies over 50% of the total area of Australia, and comprises over 115,000 economic farm properties (excludes rural residential, hobby farms and rural lifestyle blocks). However, less than 1.6% of the total economic farm numbers are actually owned by corporate or institutional investors. This low level of corporate involvement in the Australian rural property market has limited both the investment performance research and inclusion of this rural land type in both property and mixed asset investment portfolios.

In the U.S. rural land is also the most extensive real estate type based on total area occupied. The United States Department of Agriculture statistics (1998) show that in 1997 there were 2.06 million farms in the U.S., covering 968 million acres, with a total value of \$912 billion and generating an annual income of \$202 billion. The level of corporate ownership of farms in the U.S. is also higher than the level of corporate farm ownership in Australia.

This high level of institutional ownership in rural land in U.S has provided the opportunity for the rural property asset class to be analysed in relation to it's

investment performance and possible role in a mixed asset or mixed property investment portfolio.

The extent of the institutional involvement in US rural land is evidenced by the NCREIF Farmland index. This index now comprises over 470 rural properties, with a total value in excess of US\$1.1 billion.

In addition to the NCREIF Farmland index, the USDA provides an annual rural land price index and many rural based State universities also provide rural land indices.

Based on this available data there has been considerable research carried out in the U.S. on rural land. Most of this research has concentrated on:

- Inflation-hedging: Hadaway and Hadaway, 1981; Irwin et al, 1988; Kaplan, 1985; Reilly et al, 1977; Rubens et al, 1989; Rubens and Webb, 1995 and Webb and Rubens, 1987, 1988.
- Returns: Chambers, 1984; Featherstone and Baker, 1987; Fogler, 1984; Ibbotson and Fall, 1979; Ibbotson and Siegal, 1984; Kost, 1968; Robichek et al, 1972; Spiedell, 1990; White and Ziemer, 1982.
- Diversification and portfolio benefits: Case et al, 1993; Hemmerick, 1981; Irwin et al, 1988; Kaplan, 1985; Lins et al, 1992; moss et al, 1988; Rubens and Webb, 1995; Webb, 1990; Webb et al, 1988; Webb and Rubens, 1986, 1987, 1988.
- Appraisal smoothing: Lins et al, 1992; Moss et al, 1988; Webb and Rubens, 1987.
- Indices: Asche and Wessels, 1997.

Research Methodology

This paper utilises the extensive NSW based rural land return series, which have been developed by Eves (1999, 2000 and 2001), to examine the performance of rural land over the period of 1990-2000. These transaction return series have been developed using \$ per hectare as the benchmarking investment performance criteria and January 1990 benchmarked to an index value of 100. The return series have been based on six-monthly intervals. The corresponding benchmark PCA office, retail and industrial property indices are also 6-monthly over 1990-2000 (Property Council of Australia, 2000) and will allow a comparison of all major investment property types.

This performance will be compared to commercial, industrial property, as well as equities and bonds in Australia to determine the benefits of including rural land in both a mixed property and a mixed asset investment portfolio. The analysis will determine the historic role rural land would have played in the construction of a mixed asset and mixed property investment portfolio, based on the average annual capital and the average annual total return of available investment assets during the period 1990-2000.

To enable mixed-asset portfolio analysis, the following asset performance series will be assessed over 1990-2000 on an equivalent six-monthly basis:

- direct property: PCA office, retail, industrial
- shares: All Ordinaries
- bonds: 10-year bonds

Using this rural property investment performance index, a range of statistical analyses have been conducted to examine the role of rural property in an investment portfolio; particularly relating to the risk reduction and portfolio diversification benefits of rural property in an investment portfolio. All statistical analyses have been carried out using the statistical and “Solver” routines within Excel.

Capital return indices

The NSW weighted average annual capital return indices are based on the average annual change in the price per hectare for rural land on a six monthly basis during the period 1990-2000. These geographic capital return indices have been weighted on a sales volume basis (total rural property sales value per semi-annual period) to develop the NSW weighted composite capital return index, which has been used in the following analysis.

Total Return Indices

As the capital return indices developed in this study are transaction based, rather than valuation based, it is not possible to ascertain the annual net income return for each sale transaction in the six monthly periods from 1990 to 2000. However, it has been possible to determine the average annual income return for a total average NSW rural property return. The availability of verifiable farm income return data (Australian Bureau of Agriculture and Resource Economics, 1990-2000) has allowed the development of a NSW composite weighted total return index

The total return index is based on the capital return data from the sales index and the farm income and expenditure returns provided by ABARE on an annual basis. ABARE survey over 22,000 farmers in NSW annually to determine this farm economic data. Summary results for both the NSW Composite rural and the NSW Scenario Rural Returns are presented in Table 1.

The data for office, retail and industrial property, as well as shares and bonds have been obtained from the Property Council of Australia Property Index (Property Council of Australia, 2001).

Annual Capital Returns

The analysis of the rural property market and the comparison to other investment assets has been carried out on the basis of both capital returns and total returns, so that an historic investment analysis can be carried out. Comparisons have been made to the traditional property sector investment sectors of Office, retail and industrial property, as well as a comparison of composite property, shares and bonds.

Table 1: NSW Composite Rural and Scenario Rural Income Returns: 1990-2000

Period	Land Price (\$/ha)	Net Income (\$/ha)	Scenario Net Income (\$/ha)	Income Return (%)	Scenario Income Return (%)
1990-1	1092	9.76	27.58	0.89	2.53
1990-2	1194	9.75	27.57	0.82	2.31
1991-1	1236	8.63	25.42	0.70	2.06
1991-2	1190	8.63	25.42	0.73	2.14
1992-1	1263	10.73	28.84	0.85	2.28
1992-2	1189	10.75	28.88	0.90	2.43
1993-1	1212	7.15	17.31	0.59	1.43
1993-2	1165	7.15	17.33	0.61	1.49
1994-1	1220	2.9	15.92	0.24	1.30
1994-2	1488	2.9	15.90	0.19	1.07
1995-1	1292	9.82	24.67	0.76	1.91
1995-2	1297	9.82	24.67	0.76	1.90
1996-1	1417	9.1	24.04	0.64	1.70
1996-2	1178	9.11	24.05	0.77	2.04
1997-1	1232	4.97	14.32	0.40	1.16
1997-2	1208	4.98	14.33	0.41	1.19
1998-1	1299	5.27	13.90	0.41	1.07
1998-2	1377	5.28	13.93	0.38	1.01
1999-1	1348	8.85	27.23	0.66	2.02
1999-2	1479	8.85	27.23	0.60	1.84
2000-1	1570	8.28	23.63	0.53	1.50
2000-2	1663	8.28	23.65	0.50	1.42

Both the average annual returns and the investment sector correlation matrix's have also been presented as the required basis for the more detailed investment performance based on Excel Solver routines.

The solver routine analysis represents both the historic investment performance of the traditional investments of property (office, retail and industrial), shares and bonds and together with the historic investment performance for various rural property sectors.

This analysis provides an indication of the role and impact that the rural property sector would have played in an investment portfolio if it had been included in these investment portfolios over the period 1990 to 2000. An analysis of this historic capital, total and total scenario return investment performance of the NSW rural property sector provides a reliable basis for determining the possible future role that rural property could play in a diversified investment portfolio.

Analysis and discussion of the role of rural property in diversified investment portfolios has been based on the initial presentation of the investment portfolio allocations for the traditional mixed asset investment portfolios (Property, Shares and

Bonds) and the traditional mixed property investment portfolios (Office, retail and Industrial). Following the presentation of the base investment performance analysis, the NSW weighted composite investment performance results will be included to determine the change in the mixed asset or mixed property investment portfolio following the inclusion of this asset.

Capital Return Investment Performance (Property [composite], Shares, Bonds and Rural [Composite])

Table 2 shows that during the period 1990-2000 the NSW rural property market has achieved an average annual weighted (Sales volume per land use classification) capital return of 9.52%, which is considerably higher than the annual capital investment return of -2.52%, 1.61% and 8.16% respectively for composite property bonds and shares, from January 1990 to December 2000.

Table 2: Mixed Asset Average Annual Capital Return: 1990-2000

	Property	Shares	Bonds	Rural	Office	Retail	Industrial
Av. Annual Cap.Return (%)	-2.52	8.16	1.61	9.52.	-4.53	2.05	-1.47
Volatility (%)	5.05	12.81	6.53	11.49	6.94	1.58	6.02

Table 2 also shows that the higher annual capital return achieved by composite rural land was also at the second highest level of volatility for all assets in this particular comparison. While the volatility for composite property was only 5.05%, compared to 11.49% for composite rural, this is predominately due to the very low volatility for retail property (1.58%) over the study period (refer to Table 2.) During the semi-annual periods from January 1990 to December 2000, the volatility for Bonds was 6.53%, with shares exhibiting the highest volatility in the period at 12.81%.

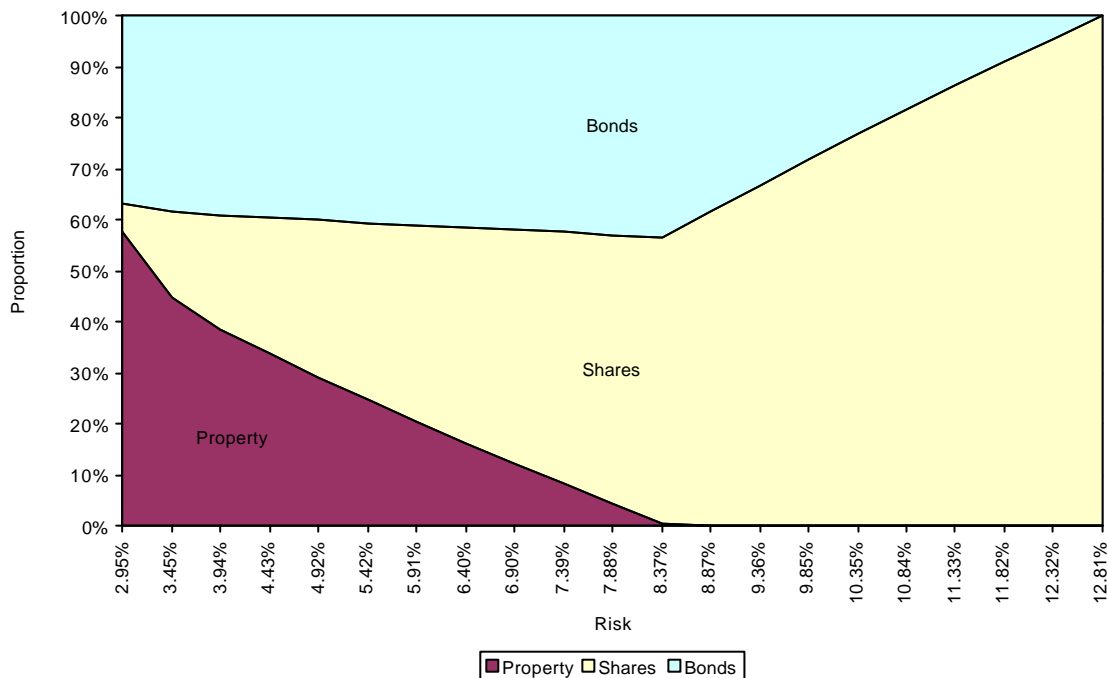
Table 3: Mixed Asset Correlation Matrix

	<i>Rural</i>	<i>Property</i>	<i>Shares</i>	<i>Bonds</i>
Rural	1.00			
Property	0.14	1.00		
Shares	-0.08	-0.22	1.00	
Bonds	-0.15	-0.43*	0.26	1.00

The correlation matrix for composite property, shares, bonds and composite rural property is shown in Table 3. This Table shows that during the period 1990 to 2000, there was no significant correlation between the changes in the annual capital return for these four (4) investment sectors. There was a slight positive correlation between shares and bonds ($r = 0.26$) and composite rural property sector and property ($r = 0.14$).

Although there were no significant positive correlations in this particular correlation matrix, there was a significant negative correlation between the change in annual capital returns for property and bonds ($r = -0.43$) and a slight negative correlation between property and shares ($r = -0.22$). The inclusion of composite rural property in the correlation analysis did not result in any significant negative or positive correlations.

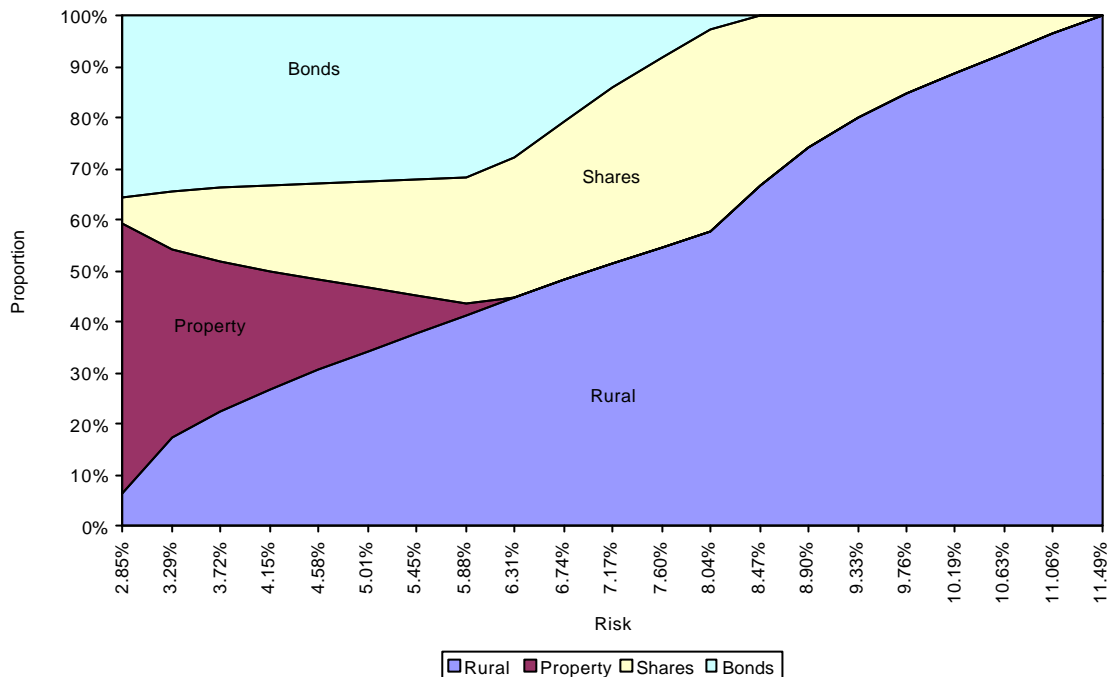
Figure 1: Mixed Asset Capital Return Optimum Investment Portfolio Allocation: 1990-2000



This indicates that from a semi-annual capital return basis, composite rural property would not provide any significant diversification benefits to the mixed asset investment portfolio, but would provide portfolio benefits due to the relatively high semi-annual capital returns for this investment asset.

Figure 1 presents the optimal mixed-asset portfolio allocation for shares/bonds and composite property based on average annual capital returns for the period 1990-2000. Based on overall capital return performance over this period, property enters the portfolio at low levels of risk (2.95-8.37%), however even at the lowest levels of risk property only makes up to 55% of the mixed asset investment portfolio at the 2.95% level of portfolio risk. Composite property would have been excluded from the mixed asset investment portfolio for the study period when the level of risk reached 8.37%. At this level of risk, shares were dominating the portfolio with a declining level of bonds in the portfolio, due to the increased annual capital return for shares at the increasing levels of volatility.

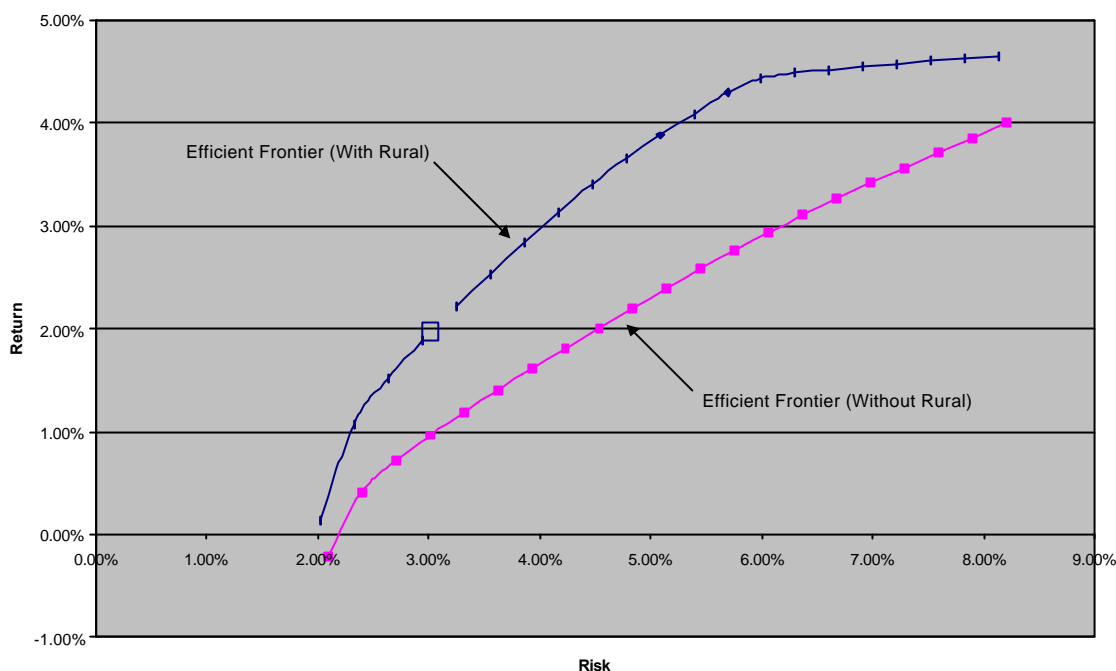
Figure 2: Mixed Asset Capital Return Optimum Investment Portfolio Allocation with Rural: 1990-2000



When composite rural property is included into the optimum portfolio (refer to Figure 2) the proportion of the traditional mixed assets in the investment portfolio changes considerably. Composite rural property comes into the portfolio in very low proportions at the lower levels of risk, but increases in its proportion of the portfolio as the level of risk increases. At the 6.7% level of risk, over 50% of the historic optimum mixed asset capital return investment portfolio would have comprised rural property, with this asset dominating the optimum portfolio up to the 11.4% risk level (100% of the portfolio). The inclusion of composite rural property actually decreases the risk of the portfolio slightly from 2.95% to 2.85%, with the maximum average annual capital return being achieved at the reduced risk level from 12.81% to 11.49%.

Figure 3 represents the capital return efficient frontier based on the mixed-asset investment portfolio of composite property, shares and bonds over the annual periods from 1990 to 2000. This figure demonstrates the impact on the risk and returns of the mixed asset investment portfolio when composite rural land is included in the portfolio. Figure 2 indicated that the inclusion of composite rural property in the portfolio decreases overall risk of the property, however Figure 3 also shows that this reduction in risk is accompanied by an overall increase in the annual capital return of the optimum mixed asset investment portfolio, particularly in the lower to middle levels of risk (2.5 to 7.0%). The inclusion of the NSW weighted composite rural land in the mixed asset investment portfolio (capital return) has a greater impact on the proportion of shares in the portfolio as both assets have higher returns at higher levels of risk compared to both composite property and bonds.

Figure 3: Efficient Frontier Comparison: Mixed Asset and Mixed Asset with Rural



Capital Return Investment Performance (Office, Retail, Industrial and Rural [Composite])

The composite property annual capital return for the period 1990 to 2000 was – 2.52%, with a volatility of 5.05%, however Table 1 shows that when the composite property annual capital returns are broken down into the individual property sectors the results vary significantly. The negative annual capital return for composite property is in fact due to the very poor annual capital return performance of the office property sector (-4.53%) and to a lesser extent the negative annual capital return performance of the industrial property sector (-1.47%).

Table 4 represents the correlation matrix for the office, retail, industrial and composite rural property sectors for the annual periods from January 1990 to December 2000.

From this table, it can be seen that there has been a very significant positive correlation between the change in semi-annual capital returns of office and industrial property sectors ($r = 0.89$), with very slight positive correlations between office and retail ($r = 0.21$) and retail and industrial ($r = 0.19$). An important aspect of this correlation analysis was that composite rural property had slight negative correlations between the traditional property investment assets of office ($r = -0.014$), retail ($r = -0.10$) and industrial ($r = -0.10$). This indicates that semi-annual periods of positive capital returns for composite rural property tended to occur in semi-annual periods of negative capital returns for office, industrial and retail property.

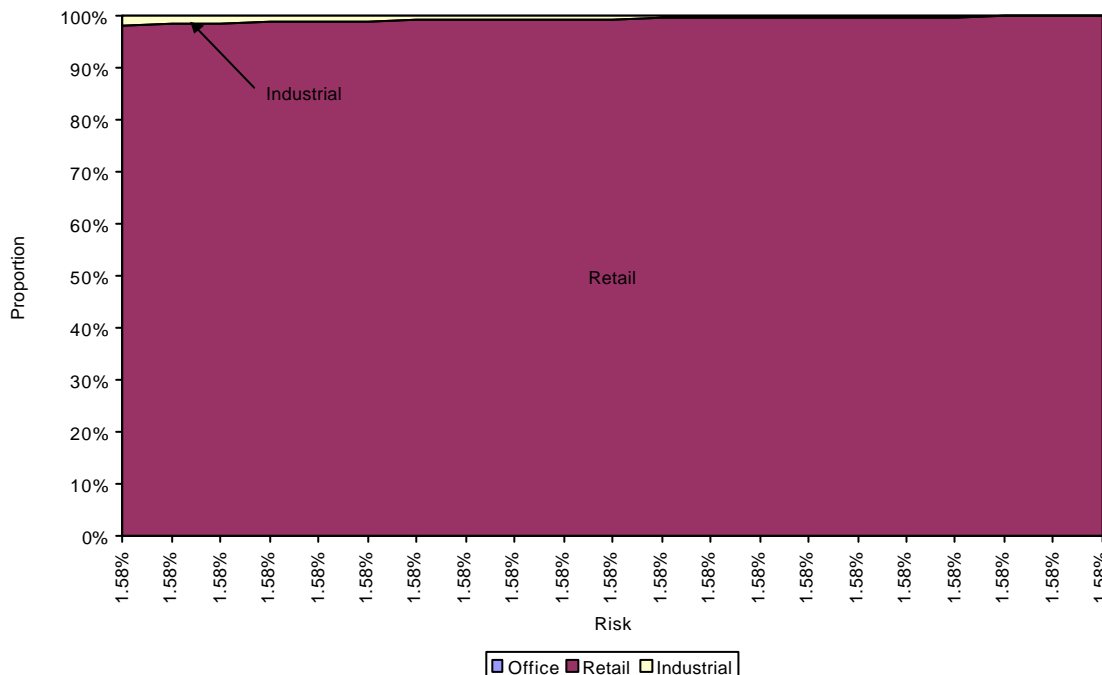
Table 4: Mixed Property Correlation Matrix: 1990-2000

	<i>Rural</i>	<i>Office</i>	<i>Retail</i>	<i>Industrial</i>
Rural	1.00			
Office	-0.01	1.00		
Retail	-0.10	0.21	1.00	
Industrial	-0.10	0.89	0.19	1.00

As previously stated the positive annual capital return achieved by retail property over the period 1990 to 2000, resulted in this property sector dominating the traditional mixed property investment portfolio allocation.

Figure 4 shows that based on the annual capital returns for office, retail and industrial property for the period 1990 to 2000, office property would not have been included in the mixed property investment portfolio at any level of risk. This figure also shows that industrial property would have only been included in the investment portfolio at very low levels of risk (1.58%). At this level of risk industrial property would still only have contributed a maximum proportion of 2% of the mixed property capital return investment portfolio.

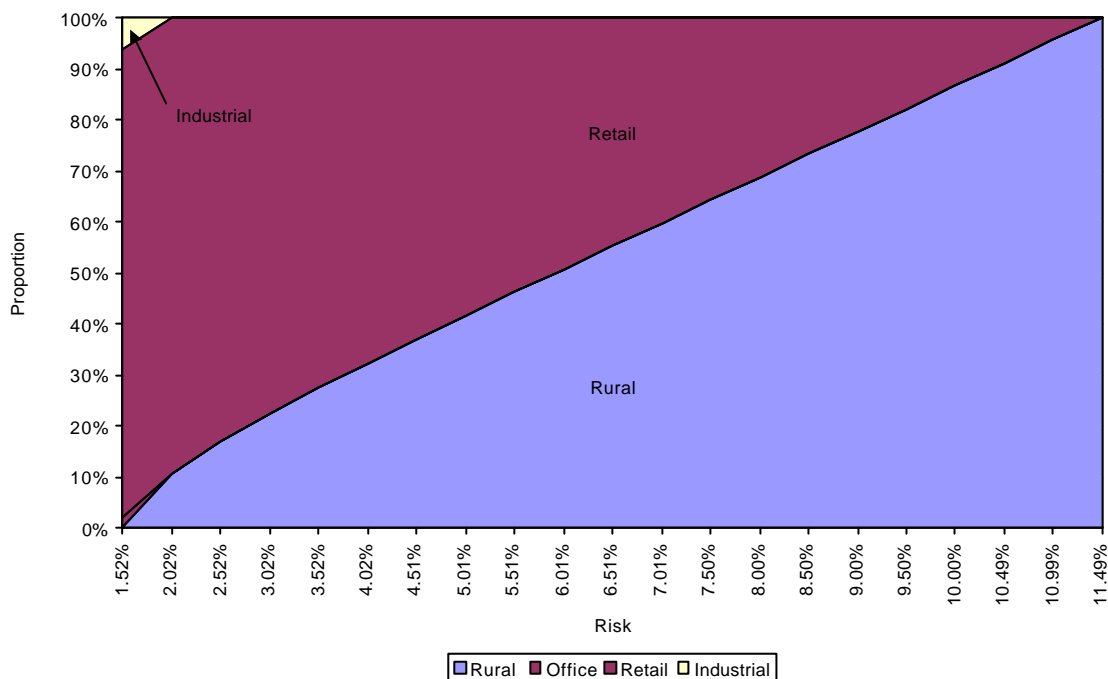
Figure 4: Mixed Asset Capital Return Optimum Investment Portfolio Allocation: 1990-2000



The inclusion of composite rural land in the mixed property capital return investment portfolio significantly alters the portfolio allocations and proportions.

Figure 5 shows that based on the annual capital returns, composite rural property enters the mixed property investment portfolio at the 1.52% risk level, but at less than 5% proportion of the portfolio. At this 1.52% level of risk, there is also a very small proportion of industrial property allocated in the mixed property + rural investment portfolio (less than 2%), but is omitted from the investment portfolio at the 2.02% risk level.

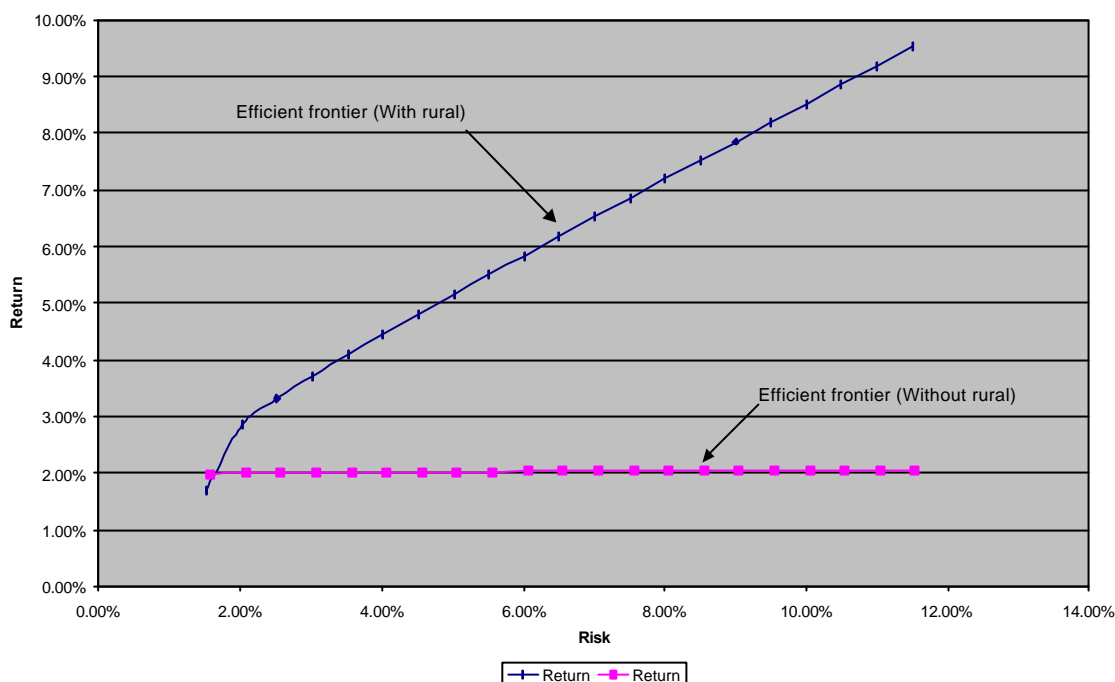
Figure 5: Mixed Asset Capital Return Optimum Investment Portfolio Allocation with rural: 1990-2000



The higher annual capital return for composite rural land, compared to office, retail and industrial property results in composite rural property increasing its allocation proportions in the mixed property portfolio as the risk level of the portfolio increases from 2.02%. At the 11.49 level the mixed property investment portfolio based on annual capital returns for the period 1990 to 2000, would have comprised only composite rural property.

The fact that only retail property returned a positive semi-annual capital return for the period 1990 to 2000, has resulted in the traditional mixed property investment portfolio having a very flat efficient frontier, with the annual capital return increasing only very slightly (less than 0.1%) as the level of risk in the portfolio increases from 1% to 8%. However Figure 6 shows that the inclusion of composite rural property results in a significantly greater efficient frontier across the same level of risk.

Figure 6: Efficient Frontier Comparison: Mixed Property and Mixed Property with Rural



Again, the inclusion of composite rural property has an advantageous affect on the performance of a mixed property investment portfolio, however additional analysis has been carried out to determine the impact of the various ABARE rural property land use classifications on the mixed property investment portfolio.

Total Return Investment Performance (Property [composite], Shares, Bonds and Rural [Composite])

The previous analysis in this paper has indicated that the NSW composite and land use rural property sectors have shown significantly higher average annual capital returns compared to other investment assets such as office, retail and industrial property and bonds. The only investment asset that achieved a similar annual capital return during the period 1990 to 2000, compared to the NSW rural property sectors, was Australian shares.

Although the annual capital returns for the various rural property sectors indicated that there inclusion in a mixed asset investment portfolio would be beneficial, capital return is only part of the total return that can be achieved by investment assets. A more suitable comparison of alternate investment assets is obtained by examining the annual income return from the investment asset as well as the annual capital return.

However, the total returns represented in Table 5 for the various asset classes shows that when annual income return is included in the total return analysis, rural property has a lower annual total return to both shares and bonds (12.72% and 11.30% respectively), but a significantly higher total average annual return than composite property at 5.12%.

Table 5: Mixed Asset Average -Annual Total Return: 1990-2000

	Property	Shares	Bonds	Rural
Av. Annual Total Return (%)	5.12	12.72	11.30	10.75
Volatility (%)	5.21	12.76	7.41	11.41

The inclusion of annual income returns to calculate a total semi-annual return for each of the asset classes has also had an impact on the correlation analysis matrix based on the changes in annual total returns. Table 6 shows that on a total annual return basis there are no significant correlations between composite rural property and shares, property and bonds. However, there is a slight negative correlation between the annual change in total returns for composite rural and shares ($r = -0.09$) and bonds ($r = -0.16$). On a total return basis, there is a significant negative correlation between composite property and bonds ($r = -0.54$) and a slight negative correlation between composite property and shares ($r = -0.21$).

Table 6: Mixed Asset Correlation Matrix: 1990-2000

	<i>Rural</i>	<i>Property</i>	<i>Shares</i>	<i>Bonds</i>
Rural	1.00			
Property	0.13	1.00		
Shares	-0.09	-0.21	1.00	
Bonds	-0.16	-0.54	0.25	1.00

Figures 7 and 8 compare the composition of the optimum investment portfolio allocations based on the annual total returns for composite property, shares, bonds and composite rural property for the period from January 1990 to December 2000.

In figure 7 it can be seen that at low levels of risk (2.85% to 3.35%) the optimum mixed asset total return portfolio is predominately based on a proportion of 35% bonds and 60% composite property, with shares only contributing 5% of the total optimum mixed asset portfolio at the 2.85% risk level. The proportion of composite property in the mixed asset optimum portfolio based on annual total returns declines as the risk levels for the portfolio increases. At the 7.31% risk level composite property is not included in the 1990 to 2000, optimum mixed asset investment portfolio. An increasing proportion of bonds generally takes up this decline in the level of composite property in the optimum mixed asset portfolio. The maximum proportion of bonds in the optimum mixed asset investment portfolio occurs at the 6.82% risk level, at which point the bond proportion of the total portfolio is 70%.

Once the level of risk exceeds the 6.82% level, the proportion of shares in the mixed asset investment optimum portfolio increase up to the 12.76% risk level, at which point the optimum mixed asset investment portfolio is comprised totally of shares

Figure 7: Mixed Asset Total Return Optimum Investment Portfolio Allocation: 1990-2000

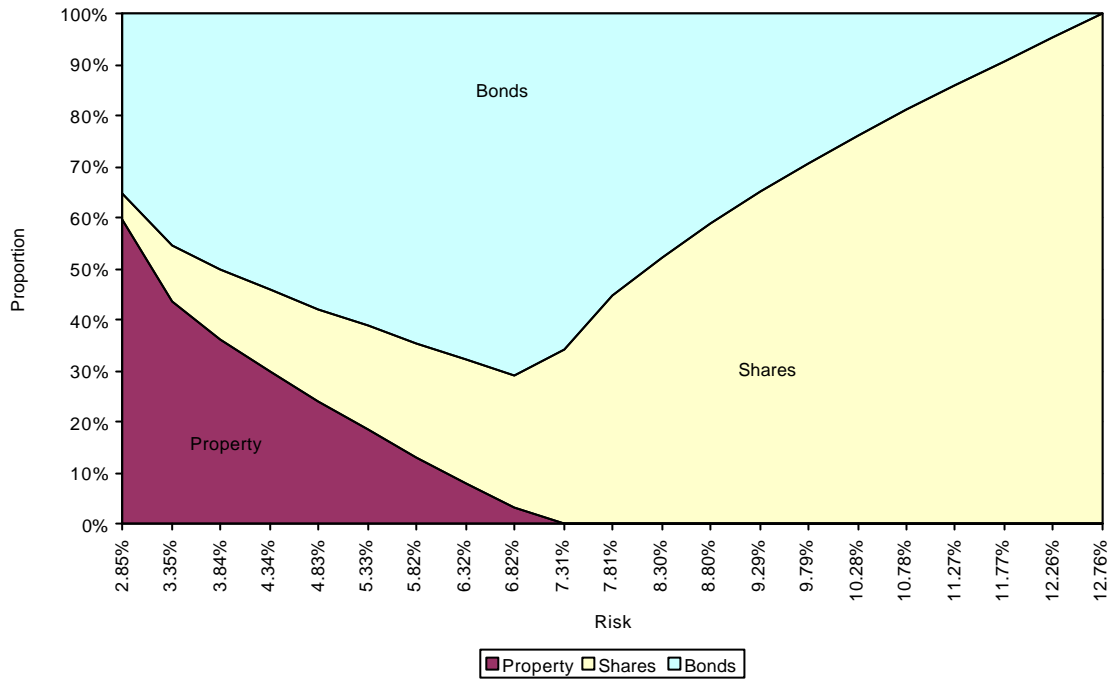
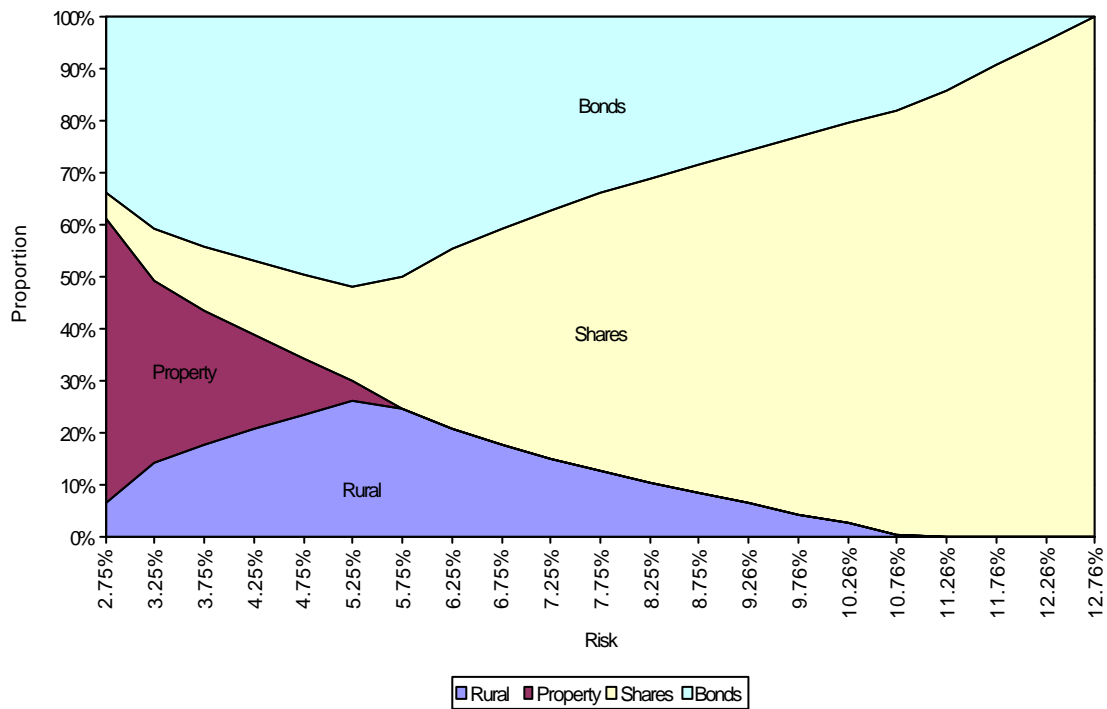


Figure 8: Mixed Asset Total Return Optimum Investment Portfolio Allocation with Rural: 1990-2000



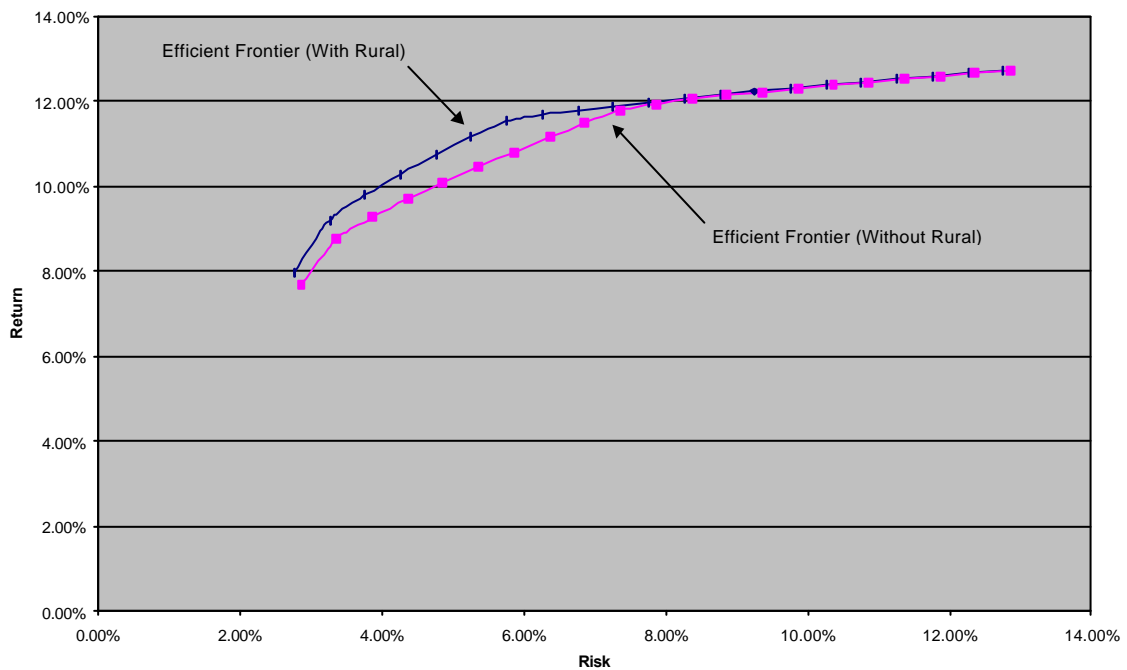
Whereas, the introduction of composite rural property (refer to Figure 9) had a significant impact on the composition of the optimum mixed asset investment

portfolio based on annual capital returns, the impact is not as great when the optimum asset portfolio is based on annual total returns. Although the introduction of composite rural property decreases the lower levels of risk for the portfolio from 2.85% to 2.75%, the proportion of rural composite property in the portfolio is not at the same proportions as was the case for the portfolio based on annual capital returns. Rural property enters the optimum mixed asset portfolio at the low risk level of 2.75%, with approximately 8% proportion of the portfolio. The maximum proportion of composite rural property occurs at the 5.25% risk level. At this risk level the proportion of composite rural land in the mixed asset investment portfolio is 25%.

The inclusion of composite rural property is at the expense of composite property, which has a reduced proportion at the lowest level of risk and leaves the portfolio at the 5.75% risk level (7.31% without the inclusion of composite rural property). The inclusion of composite rural property also slightly reduces the proportion of shares in the optimum mixed asset investment portfolio in the mid range levels of risk.

The efficient frontiers represented in Figure 10 confirms that the inclusion of composite rural property in the optimum mixed asset investment portfolio has the most impact on the reduction of portfolio risk and increased portfolio return at the low to mid levels of risk and has limited impact on the optimum portfolio once risk levels exceed 7%.

Figure 10: Efficient Frontier Comparison: Mixed Asset and Mixed Asset with Rural



Total Return Investment Performance (Office, Retail, Industrial and Composite rural)

The analysis of the mixed asset investment performance based on annual total returns resulted in a greater role for composite rural property in a mixed asset investment portfolio compared to the analysis based on annual capital returns only.

Table 7: Mixed Property Average Annual Total Return: 1990-2000

	Office	Retail	Industrial	Rural
Average Annual Total Return (%)	2.60	10.36	8.60	10.75
Volatility (%)	7.24	1.82	5.95	11.41

Table 7 shows that on the basis of the analysis of annual total returns over the period 1990 to 2000, composite rural land has achieved a higher total return to office, industrial and retail property.

Over this period the annual total return for composite rural property has been 10.75%, which is slightly higher than the equivalent study period annual total return for retail property (10.36%) and industrial property (8.60%) but significantly greater than the annual total return for the office property sector of only 2.60%. Although composite rural property has achieved the highest annual total return, compared to the traditional property investment assets, its volatility of 11.41% was significantly higher than retail property with a volatility of only 1.82%. This difference in volatility has the potential to limit the dominance of composite rural property in a mixed property investment portfolio.

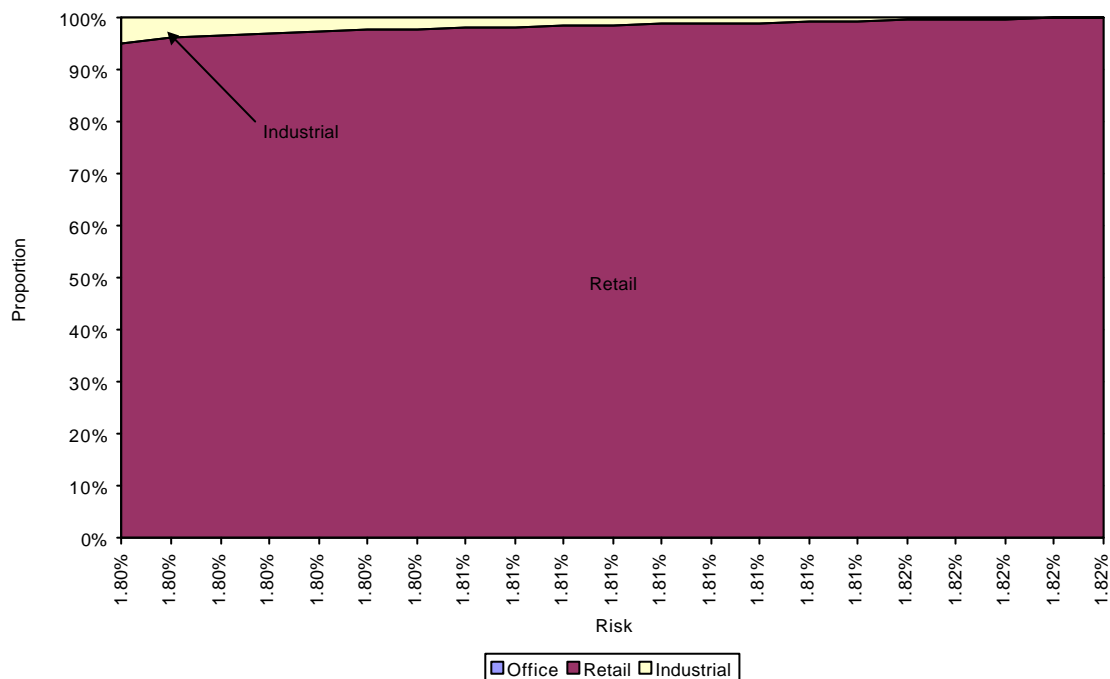
Table 8: Mixed Property Correlation Matrix: 1990-2000

	<i>Rural</i>	<i>Office</i>	<i>Retail</i>	<i>Industrial</i>
Rural	1.00			
Office	0.13	1.00		
Retail	0.09	0.18	1.00	
Industrial	0.01	0.90	0.15	1.00

The correlation matrix in Table 8 shows that there is only a significant positive correlation between office and industrial property ($r = 0.90$) and a slight positive correlation in the change in annual total returns between office and retail ($r = 0.18$). All other correlations in the matrix are minimal, but unlike the same correlation matrix based on annual capital returns, there are no negative correlations in this analysis. This suggests that on an annual total return basis the inclusion of composite rural property would not have significant portfolio diversification benefits.

Figure 11 represents the mixed property investment portfolio allocations based on the annual total returns for office, retail and industrial property in NSW over the period 1990 to 2000. This figure confirms the dominance of retail property in the mixed property investment portfolio due to the higher annual return and very low risk of this asset compared to office and industrial property. The lower annual total returns for the office property sector (2.60%), combined with comparatively high volatility (7.24%) to the risk for retail and industrial, has resulted in office property not being represented in the mixed property investment portfolio over the period of the study (1990-2000).

Figure 11: Mixed Property Total Return Optimum Investment Portfolio Allocation: 1990-2000



Industrial property is included in the mixed property investment portfolio at the lowest levels of risk, however the proportion of industrial property in the portfolio is never more than 5%. Figure 11 shows that the risk profile of this optimum investment portfolio allocation is extremely narrow ranging from only 1.80% to 1.82%, while still achieving the maximum portfolio return of 10.36%.

However, when the composite rural property sector annual total returns are included in the mixed property total return investment portfolio, it has a major impact on the portfolio allocations.

Figure 12 represents the mixed property investment portfolio allocations based on the inclusion of the composite rural property annual total returns. This figure shows that the higher annual total return of 10.75% has significantly altered the proportion of retail property in the optimum investment portfolio. Although the annual total return for rural composite property was higher than the annual total return for retail property, it does not have the same dominance of the portfolio as retail property had in the

previous allocation in Figure 11, as the volatility of rural property was higher at 11.41%.

Figure 12 Mixed Property Total Return Optimum Investment Portfolio Allocation with Rural: 1990-2000

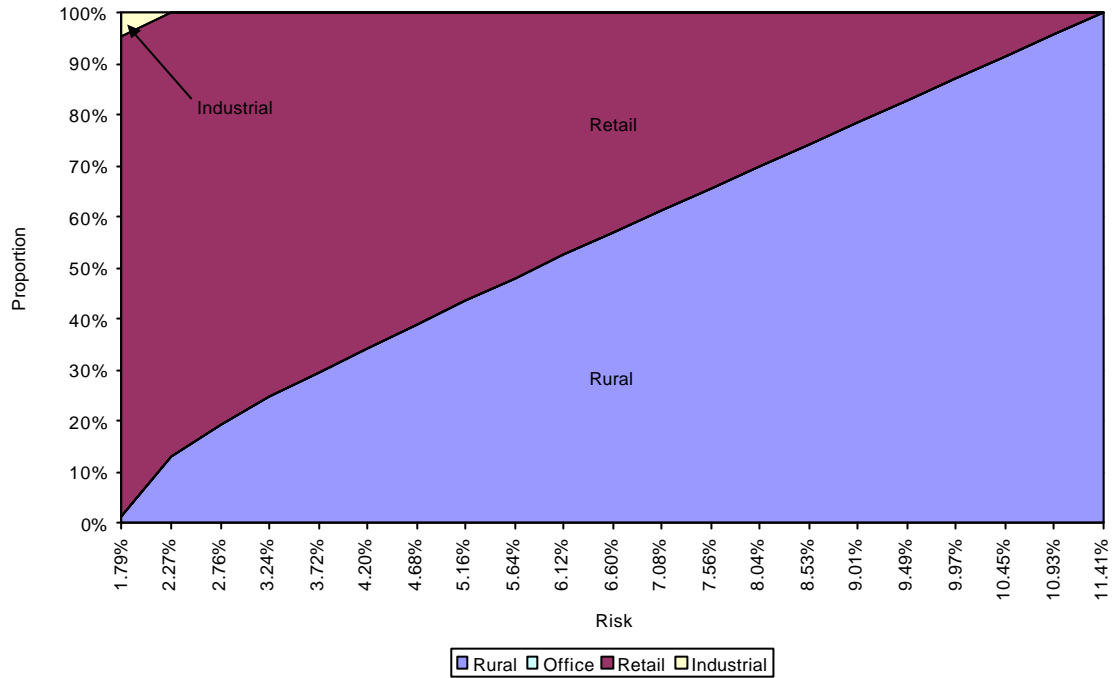
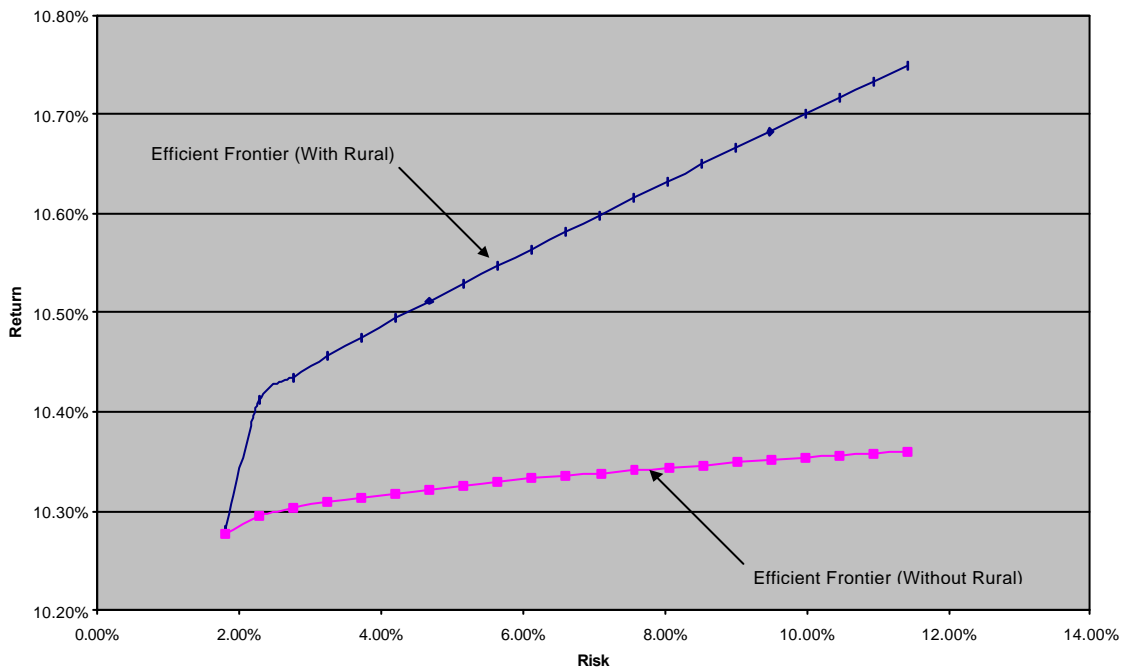


Figure 13: Efficient Frontier Comparison: Mixed Property and Mixed Property with Rural



Composite rural property enters the portfolio at all levels of risk, but the proportion of rural property in the optimum mixed property investment portfolio is less than 10% until the risk level of the portfolio reaches 2.27%. Once the risk level of the portfolio exceeds 2.76% level, the proportion of rural property in the optimum mixed property portfolio increases significantly. The inclusion of rural land in mixed property investment portfolio initially replaces the proportion of industrial land in the portfolio at the lower risk levels, but replaces the retail property sector at the higher risk levels.

A comparison of the two optimum portfolio (mixed property without rural property and mixed property with composite rural) efficient frontiers is presented in Figure 13. This figure highlights the substantial impact the inclusion of composite rural property has on both the risk profile and return profile of the optimum investment portfolio based on property sector assets. The inclusion of rural property in the mixed asset investment portfolio increases the portfolio returns at all levels of risk.

Total Return Scenario

The following tables and figures are based on the scenario that the top 18% of NSW rural properties generate over 55% of total agricultural turnover per annum. This analysis resulted in a considerable increase in annual income return (refer to Table 1) for all rural property in NSW. These revised annual income returns were added to the unadjusted capital returns to determine the scenario total returns. These rural property sector scenario results have been presented in the same format as the actual property sector analysis

Table 9 shows that under the scenario parameters the annual total return for composite rural property has increased from 10.75% to 13.21% (an increase of 22.9%), with no reduction in annual volatility.

Table 9: Mixed Asset Average Annual Scenario Total Return: 1990-2000 (Scenario)

	Property	Shares	Bonds	Rural
Average Annual Total Return (%)	5.12	12.72	11.30	13.21
Volatility (%)	5.21	12.76	7.41	11.41

The only change in the correlation matrix between this scenario analysis and the semi-annual total return analysis, as shown in Tables 6 and Table 10 is that the negative correlation between rural property and shares has increased from ($r = 0.09$) to ($r = -0.10$). Under the scenario parameters, all other correlations have remained constant.

The inclusion of only the top 20% of farms increases the semi-annual total returns of the composite rural property sector to the point where this asset becomes a major component of the optimum investment portfolio at the mid to high risk levels.

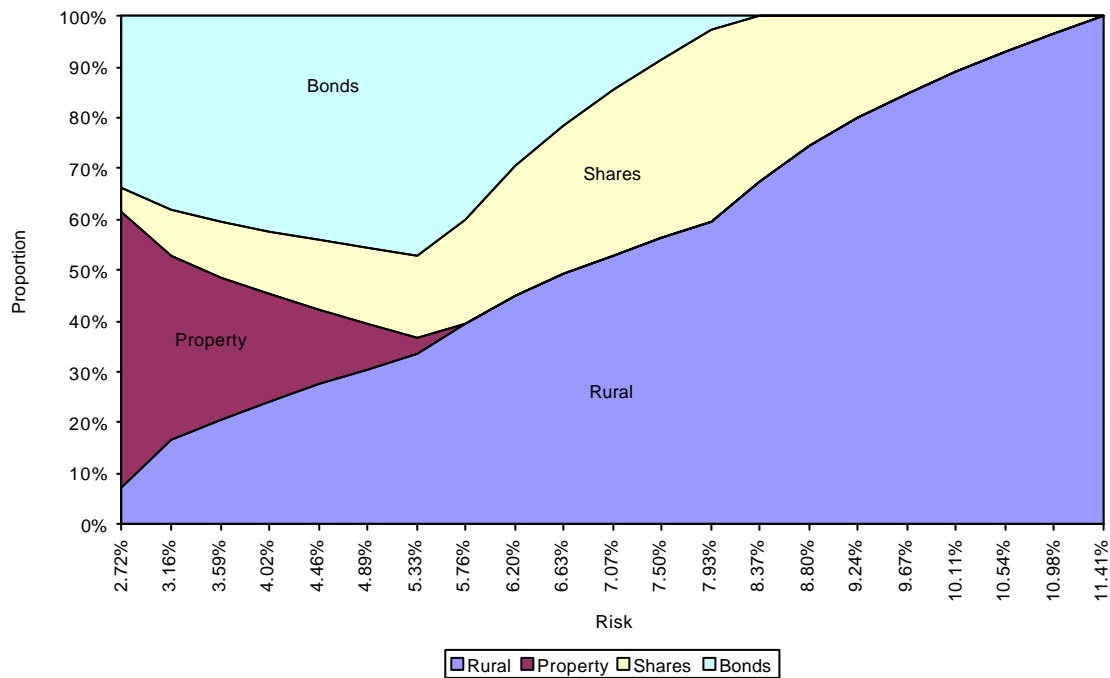
Figure 14 shows that under the total return scenario results composite rural property enters the portfolio at all levels of risk, and then rises as a percentage of the total portfolio to the 8.08% risk level, at which point the entire optimum investment portfolio is based on composite rural property.

Table 10: Mixed Asset Correlation Matrix: 1990-2000 (Scenario)

	<i>Rural</i>	<i>Property</i>	<i>Shares</i>	<i>Bonds</i>
Rural	1.00			
Property	0.10	1.00		
Shares	-0.10	-0.21	1.00	
Bonds	-0.16	-0.54	0.25	1.00

This increase in the proportion of rural property in the optimum portfolio is at the expense of property and bonds at the lower levels of risk and shares at the higher risk levels. The major impact of including only the better farm properties in the investment portfolio is evidenced when the scenario results are compared to the average NSW annual total returns.

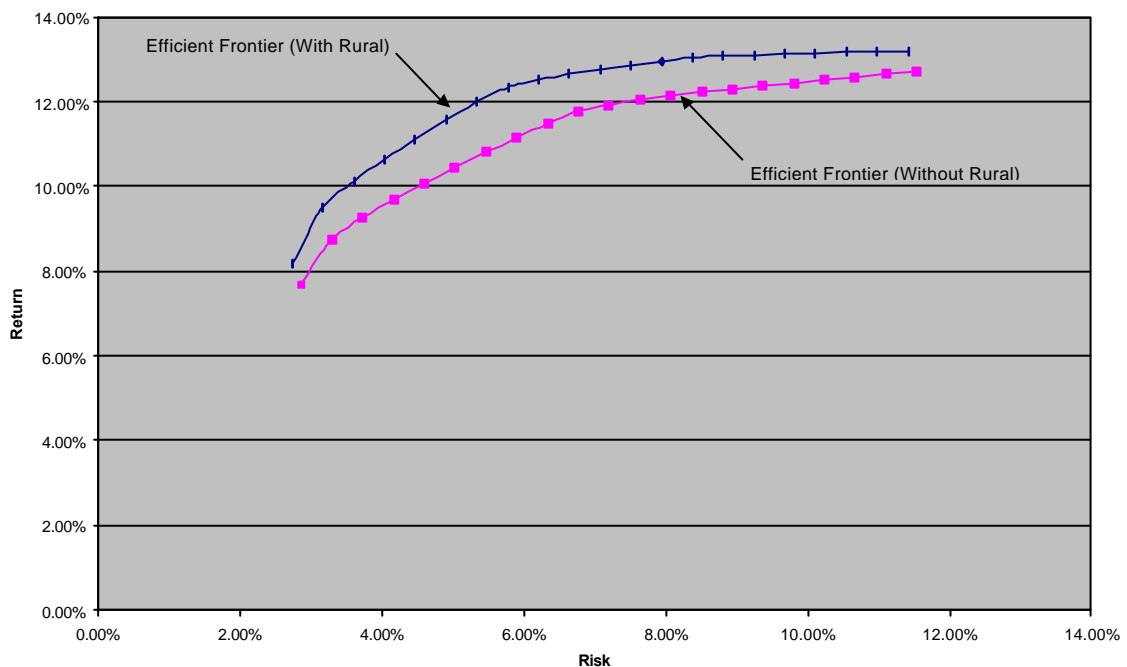
Figure 14: Mixed Asset Total Return Scenario Optimum Investment Portfolio Allocation with Rural: 1990-2000



In Figure 8 rural property achieved its maximum proportion of the optimum investment portfolio of 25% at the 5.25% risk level and was excluded from the optimum investment portfolio once the risk was greater than 10.75%. Under the scenario analysis, rural land accounts for over 40% of the portfolio at the 5.76% risk level and made up 50% of the mixed asset optimum investment portfolio at the 7.07% risk level.

Figure 15 compares the efficient frontiers of composite rural property semi-annual total returns for both the NSW average and the top 20% of NSW rural properties. From this figure it can be seen that identifying the total return of the better NSW farmers results in higher returns at all levels of portfolio risk, especially in the range of risk levels from 4.00% to 10.00%.

Figure 15: Efficient Frontier Comparison: Mixed Asset and Mixed Asset with Rural (Scenario)



Mixed Property

The additional average semi-annual total return that is generated by the higher average annual income returns based on the best 20% of NSW farmers has resulted in the rural property sector outperforming all other mixed property investment assets in NSW for the 11-year period (1990 to 2000).

Table 11: Mixed Property Average Annual Total Return: Scenario: 1990-2000

	Office	Retail	Industrial	Rural
Average Annual Total Return (%)	2.60	10.36	8.60	13.21
Volatility (%)	7.24	1.82	5.95	11.41

Table 11 shows that the difference between average annual total return for composite property and the other assets ranges from 5.11% for office to a lowest difference of 0.9% for retail property. The lower annual total returns for NSW office, retail and industrial property compared to composite rural property will have a similar result in the allocation of mixed property assets in the optimum investment portfolio as that which occurred in the mixed asset portfolio when the higher scenario annual total returns were included in the analysis.

The change in the annual average total return and the volatility of these returns has also resulted in some changes in the correlation between the changes in the average semi-annual total returns for composite rural property and office, retail and industrial property sectors. Table 12 represents the correlation matrix for NSW mixed property investment sectors based on the scenario parameters for the NSW composite rural property sector.

Table 12: Mixed Asset Correlation Matrix: 1990-2000 (Scenario)

	<i>Rural</i>	<i>Office</i>	<i>Retail</i>	<i>Industrial</i>
Rural	1.00			
Office	0.10	1.00		
Retail	0.10	0.18	1.00	
Industrial	-0.01	0.90	0.15	1.00

Comparison with Tables 8 and 12 reveals that under the scenario correlation matrix the slight positive correlation between composite rural/office has decreased from $r = 0.13$ to $r = 0.10$, the slight positive correlation between composite rural and the retail property sector has increased very slightly from $r = 0.09$ to $r = 0.10$, while the very correlation between composite rural and industrial property has moved from $r = 0.01$ to $r = -0.01$.

Figure 16 shows that the inclusion of the average annual total returns based on the semi-annual income returns from the top 20% of NSW rural properties has also resulted in the efficient frontier for the scenario based optimum mixed property investment portfolio providing higher semi-annual total returns at all levels of risk in the portfolio than the optimum investment portfolio without composite rural property.

Figure 16: Mixed Property Total Return Scenario Optimum Investment Portfolio Allocation with Rural: 1990-2000

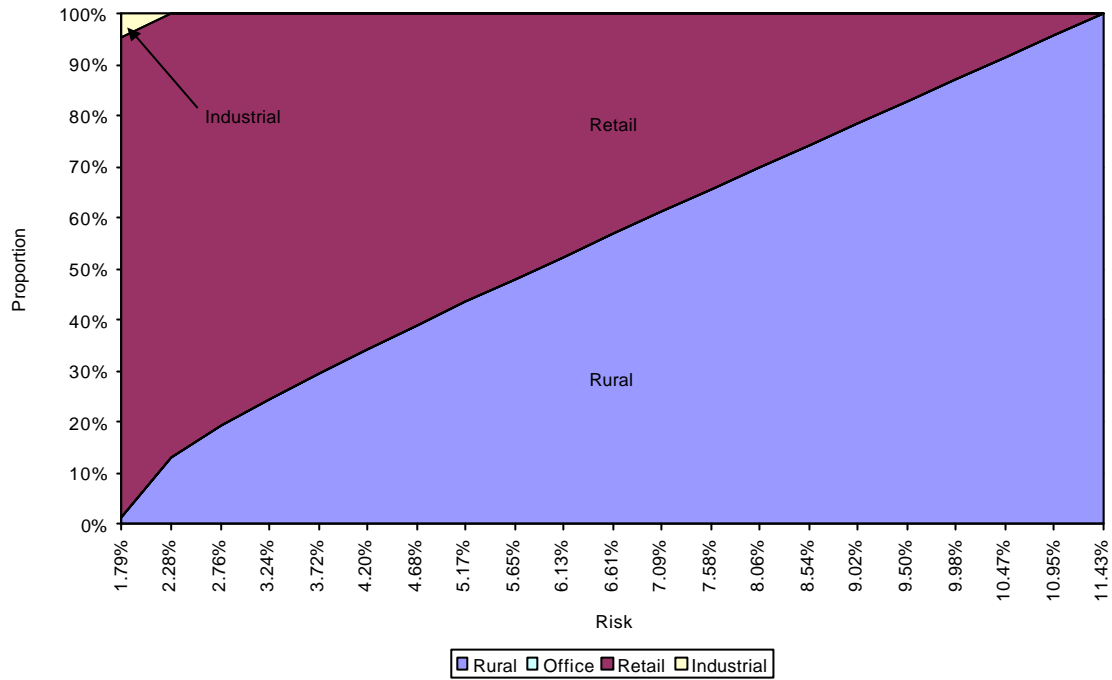
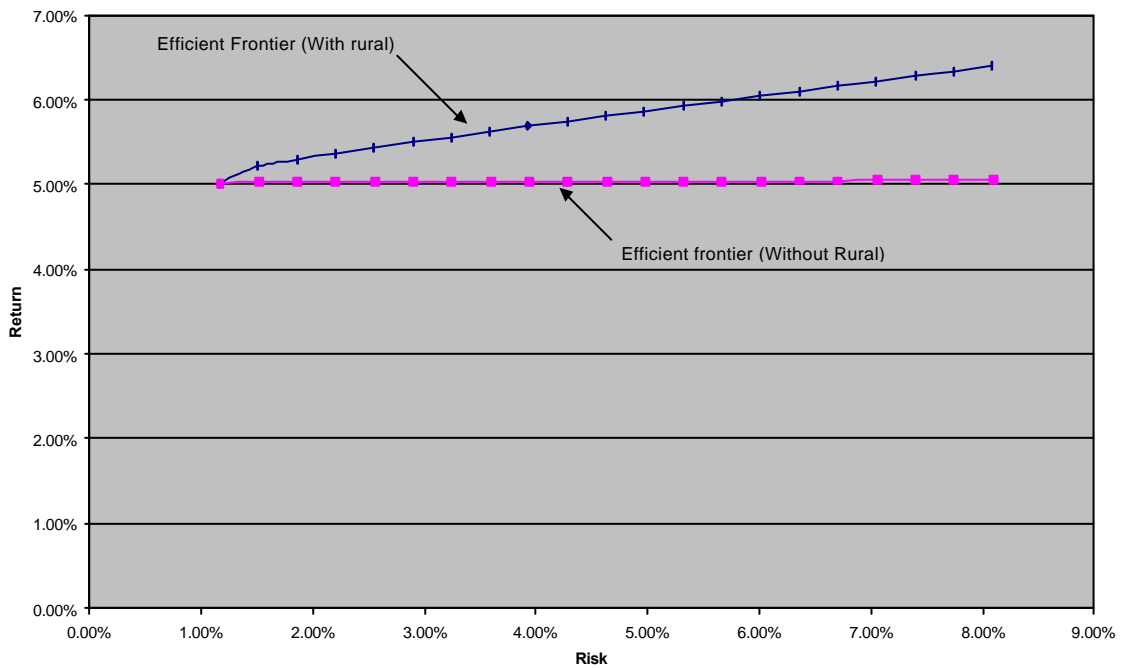


Figure 17: Efficient Frontier Comparison: Mixed Property and Mixed Property with Rural (Scenario)



Again the comparison of Figure 16 to the annual total return mixed property investment portfolio based only on the average income returns from NSW rural

properties results in the only change in the two portfolios being the slight reduction in the overall risk of the portfolio from 1.80% to 1.79%.

The change in annual total returns, based on the increased scenario annual income returns, has not significantly altered the asset allocations for the mixed property assets in the two portfolios.

Conclusions

The analysis of the NSW rural property performance series has provided useful insights into the risk-adjusted performance of Australian rural property over the period 1990-2000.

Unlike commercial, retail and industrial property sectors, the rural property sector has had the majority of the total average annual return generated from capital returns, whereas the office, retail and industrial property sectors had a greater reliance on income returns in their total annual return performance.

Key results to emerge for rural land, in comparison to office, retail and industrial property sectors, are the portfolio diversification benefits (via low inter-asset correlations) and the potential role in both a mixed-asset and a mixed property investment portfolio.

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