Where The Money Is: Determinants and Variability of Farm Profits in Western Australia

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Abstract

The purpose of this study is to examine the extensive database of individual farm records from Western Australia and investigate whether there exists useful information for farmers and financial advisors. Using STATA v8, panel data models were estimated for the determinants of profitability. Cross sectional information was used to gauge transition rates of farm profits and the causes of this variability. Farm size, level of specialisation, debt-to-asset ratio, average yield, rainfall and operating cost ratios were significant in determining farm profitability. High income mobility was evident in the farms and this variability was found to be significantly affected by farm size, debt-to-asset ratio, specialisation, and variation in crop income.

1.0 Introduction

BankWest is a major provider of financial services to farms in Western Australia. Each year BankWest publishes 'BankWest Benchmarks', the results of an annual survey of its farming based clients. The purpose of this study is to examine the extensive data base of individual farm records made available by BankWest and investigate whether there exits information that may be useful to farmers and financial advisors.

Many studies have addressed the question: "what elements of a farm business are critical in determining the level of profitability?" and a variety of techniques have been used. According to Lall et al (2001), profitability can be specified as a function of four decision activities; input, outputs, diversification and risk as well as a group of family and farm characteristics. Gloy et al (2001) estimate two models, firstly; a panel model and secondly; a fixed effects model with ordinary least squares using time series cross section analysis. Previous studies found a range of significant elements including farm size, age, costs, prices, level of diversification, proportion of land rented and debt to asset ratios.

Income mobility and consistency are important measures in understanding the financial environment faced by farmers. Phimister et al (2004) use a range of descriptive and econometric techniques applied in the analysis of the dynamics of poverty (Jarvis and Jenkins 1998; Jenkins and Rigg, 2001). They follow a standard way of assessing the extent of year-to-year movements in income by calculating the transition rates between specified income groups, a method available on STATA, the statistical package employed on this study. They conclude there are high levels of income mobility across farms. Dun and Williams (2001) use cross sectional data to determine the impact of farm based elements on the standard deviation of income and find that the standard deviation of government payments, gross crop income and gross livestock income as well as diversification, age and land rented were significant.

2.0 Data

The data for this study were obtained from the BankWest Benchmarking survey performed by BankWest each year to their farming based clients. The survey in its current form has been running for nine consecutive years and each year approximately 500 farmers complete the surveys. The data examined was from 1994/1995 to 2003/2004. The data set contained whole farm records for individual farms and in total 1290 individual farms took part in the survey. Records were predominantly financial, with income and expenditures categorised into numerous areas. There were also some physical records in stocking rates, yields, farm size and rainfall. The consistency of farms within the survey sample was not particularly high, with 70% of the farms only in the sample for four years or less. All financial variables were adjusted to 1994 dollars using the inflation deflator provided by the Reserve Bank of Australia.

Net farm income (NFI) was calculated by subtracting total costs from gross farm income. Return on Assets (ROA) was calculated using the formula used by BankWest in their analysis:

ROA= [Farm Income – Operating Expenditure – (0.1 x Machinery Assets) – 30 000 – Bank Interest Expenditure – Stock Interest Expenditure – Bills Expenditure] / [Total Assets – Property Assets – Total Liabilities]

Kay and Edwards (1994) state that NFI is not an accurate measure of farm profitability. Profitability is concerned with size of the profit relative to the size of the business, or to the value of the resources used to produce the profit. A business can show a profit, but the net gain may be small relative to total size of that business. A more accurate measure of profitability is ROA. ROA is measured in percent and is calculated by dividing total return to assets by average farm asset value.

Following the work of Purdy et al (1997), the Herfindahl index was used to measure the level of specialisation/diversification a farm had. This index was calculated as the sum of the square of the proportion of farm income from crops, livestock and other sources. A value close to one indicates highly specialised farming practices while a value close to zero indicates a highly diversified farm structure.

Variability in farm profits was measured as the standard deviation of Return on Assets. To examine the effect of farm characteristics on the standard deviation of net farm income, the data were collapsed to means and all farms that were in the survey for two years or less were omitted. This resulted in a cross-section data set of 667 observations of each variable

3.0 Models

3.1 Determinants

Panel data sets provide a rich source of information and enable regressions to capture variations across groups and time (Dunn and Williams, 2001). The fundamental advantage of a panel data set over a cross section is that it allows the researcher greater flexibility in modelling the differences in behaviours across groups (Greene, 1997). Panel regressions take two general forms, a fixed effects and random effects. The FE model assumes that differences between cross section and/or time can be viewed as parametric shifts in the regression. The RE model however uses random error in time, space or both to derive efficient unbiased estimates. The appropriate choice of model was determined using the Hausman specification test. A significant result from this test indicates that

the fixed effect model is preferred. The following model was used to estimate the impact of variables on farm profitability.

ROA = F(Year, Rain, EffLnd, D/A, Herf, Rented, Yield, OpCost, Region) (1)

Where; *ROA* is the Return on Assets, *Year* is a set of dummy variables for the year of measurements, *Rain* is annual rainfall, *EffLnd* is total effective land, *OpCost* is the operating cost ratio, *D/A* is the debt to asset ratio, *Yield* is the average yield across all crops, *Rented* is the proportion of total land rented, *Herf* is the Herfindahl index for specialisation/diversification and *Region* is a set of dummy variables for the regions; Central Midlands Great Southern, North Eastern Wheatbelt, Northern Wheatbelt < 350mm, Northern Wheatbelt > 350mm, South Coast and South Eastern Wheatbelt.

3.2 Variability

The cross sectional model examined the effect of certain farm characteristics on the standard deviation of farm profitability. The following model was estimated using ordinary least squares (OLS) regression with STATA v8.0 using the standard deviation of ROA as the dependant variable.

SDROA = F(MRain, MEffLnd, MOpCost, MD/A, MYield, MRented, MHerf, SDOpExp, SDCropInc, SDStockInc, Region) (2)

Where M_ indicates the mean value of the variables in equation (1) *SDROA* is the standard deviation of return on assets, *SDOpExp* is the standard deviation of operating expenditure, *SDCropInc* is the standard deviation of crop income, *SDStockInc* is the standard deviation of stock income and Region is the same set of dummy variables as in equation (1).

4.0 Results and Discussion

4.1 Determinants

All the variables included in the model for the determinants of ROA were found to be statically significant with the exception of the dummy variables for region. The Hausman specification test was found to be insignificant and thus the random effects model was used.

Farm Size in *Effind* was positively significant indicating that an increase in farm size will increase the level of profitability of the farm. The study by Gloy et al (2001) also showed that larger farms tended to be more profitable and had larger compound ROA and numerous other studies indicate that farm size is positively related to financial performance (Boessen et al, 1990; Ford and Shonkwiler, 1994; Purdy et al, 1997). All papers attribute this relationship to the benefits of economies of scale and bulk buying power gained with an increase in farm size. The proportion of land rented was also positively related to ROA, thus a higher proportion of rented land results in an increase in profitability. This result is consistent with the papers by Purdy et al (1997) who found that ownership of land decreased mean rates of return.

Average yield was positively related to ROA, a result that was expected. This indicates that higher yields result in higher ROA. This is intrinsic as higher yields result in higher returns to land and result in higher crop incomes. Rain was also positive another expected result. In the dry wheatbelt areas rain is vital in cropping and thus higher rainfalls will be associated with bumper crops and thus increase income and profits.

The level of specialisation/diversification was highly positively significant. This is an interesting outcome as it suggests that as the Herfindahl index increases, indicating a higher level of specialisation, ROA increased. Purdy et al (2001) found similar results and suggested that the higher profitability associated with higher specialisation could also be due to the benefits of economies of scale.

The debt to asset ratio was negatively related to ROA. Thus a decrease in leverage resulted in a decrease in financial performance. In Australian farms higher leverage may be necessary in order to invest in large scale machinery required for efficient farm operation. Operating cost ratio was negatively related to ROA. This is supported by the findings of Schnitkey (2001); Taylor et al (2002) and of Purdy et al (1997) whose study found that operating expense ratio was significantly and negatively to ROA. Given the relative importance of operating costs in profit and return calculations, and thus a close relationship with the dependant variable existing, these results are not surprising (Purdy et al, 1997).

4.2 Income Mobility

Table 5.1 Transition Matrix: Year to Year movements between quartile groups

Return on Assets					
Quartile	*1*	*2*	*3*	*4*	*Total*
1	39.6	24.3	18.7	17.4	100
2	26.3	30.6	25.5	17.7	100
3	16.9	25.9	32.8	24.3	100
4	17.1	19.5	24.7	38.7	100
Farm Income					
Quartile	*1*	*2*	*3*	*4*	*Total*
1	77.4	18.7	3.5	0.4	100
2	21.6	51.5	21.7	5.2	100
3	3	25.1	53.1	18.8	100
4	0.6	3.6	20.3	75.5	100

Tables 5.1 displays the transition probabilities of farm profitability. This table indicates that farm ranked in the top quartile, according to ROA, have a 39.6% chance of staying in the top quartile in the following year, a 24.3% of dropping to the second quartile, an 18.7% of dropping two quartiles to the third quartile and a 17.4% chance of falling into the bottom quartile. The highlighted figures represent the proportion of farms that remained in the same income group between two years.

The table indicates an extremely high fluctuation in profits amongst Western Australian farms. There was a substantial amount of long-range income mobility within the sample with, in the case of ROA, between 16.9 and 36.6% of farms in each income group moving two or more income groups in a year. Similar results were obtained by Phimister et al (2004) on UK farms. Income mobility observed suggests that there is considerable variation in individual yields, returns and costs from year to year which is not perfectly correlated across farms.

However what stands out in this table is the vast difference in results between the two variables. FI shows that there is extremely low long range income mobility (3.9-4.2% of farms moving two or

more groups) when compared to ROA. FI appears very stable with 77.4% and 75.5% of top and bottom quartile farms remaining in that quartile a huge contrast to the 39.6 and 38.7% of ROA. The differences may be attributed to the calculation of the variables. ROA accounts for farm size through the inclusion of farm assets and thus high fluctuations are possibly the result of fluctuations in the asset and liability holdings of farms rather than from changes in the level of income being raised by the farm. The lack of movement in FI confirms this.

4.3 Determinants of Variability

In the analysis of what farm variables affect the variability of ROA mean effective land total was found to be highly significant. The coefficient was negative and small. This indicated that it would take a large increase in farm size for the variability of ROA to be reduced to any great degree. MRain was found to have no impact on variability, most likely due to the fact that rainfall is generally a wide spread effect and major droughts/floods that may affect entire regions and in many cases the entire state.

The mean debt-to-asset ratio was statistically significant. The positive coefficient suggests that an increase in the level of debt of a farm or the decrease in the level of assets will result in an increase in the variability of ROA. The fact that this variable contains elements that used for the ROA calculation this significant relationship is perhaps not surprising. The mean proportion of land rented was also statistically significant. With a positive coefficient an increase in the proportion of land a farm rents results in an increase in variability of ROA.

Mean Herfindahl index value was found to be significant at the 5% level. This measurement of diversification/specialisation had a highly positive coefficient. Thus a positive coefficient is indicative that high level of specialisation on farm businesses exposes the farm to much higher levels of variability in profits. This is consistent with previous studies and portfolio theory, the theory behind the rational of diversification.

The standard deviation of crop income was found to be statistically significant, however mean yield, standard deviation in stock income and standard deviation of other income were not statistically significant at the 5% level. This suggests that the variation in crop income is an important factor in income variation while variation in stock income and other income sources does not impact on profit variability. This may be due to the fact that majority of farms in the sample obtain most of their income from cropping, as a result fluctuations in crop income will have a higher impact on ROA than any fluctuations in stock or other income. The fact that standard deviation of crop income was significant while mean yield was not suggest that it is crop prices that have the greater impact on income rather than the level of crop harvested. The standard deviation of operating expenditure was also found to be insignificant indicating that fluctuations in profit are more associated with fluctuations in income than in fluctuations in farm costs.

The region that the farm fell into did not have any significant affect on the variability of ROA, indicating that region not only does not impact significantly on the level of profitability but also has no significant impact on fluctuations within the ROA.

5.0 Conclusions

Farm profitability has been shown to be a complex aspect of the farm business, with different variable affecting both the level and variability of profits. With farm size, proportion of land rented, level of diversification, average yield, rain, leverage and operating costs all impacting on the level of

return. While farm size, leverage, diversification, proportion of rented land and variability of crop income were found to impact on the variability of profits. There was also found to be high levels of long range profit mobility, but low mobility of farm income. These aspects can be used to advise farmers more effectively when making management decisions about the farm business.

6.0 References

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