An economic analysis of sheep flock structure for broad acre farm businesses

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Summary

A strategic question facing many mixed enterprise broadacre farm businesses in Australia is, 'What sheep flock size and structure is most profitable to complement the farm's cropping enterprises?' This study answers this question for a typical large mixed enterprise farm business in a key production region of Western Australia. Whole-farm bioeconomic modelling, combined with broad-ranging sensitivity analysis, is used to examine the profitability of different sheep flock structures and sizes. Whole-farm planning allows farmers to identify what areas of the farm system are current and potential drivers of profit, and how they should be managed to maximise whole-farm profit. We have conducted a whole-farm analysis that illustrates how the structure of a farm's sheep flock, its rotations across a range of soils and overall cropping intensity are all factors that significantly affect profit and need to be considered when determining an optimal farm strategy. This study assessed the role and profitability of different flock structures in a mixed enterprise farm business in the grainbelt region of Western Australia. We found that farm profit was greater when a Merino flock turning off finished lambs was selected. These flocks remained the most profitable among a range of flock options, even if key input prices and commodity prices were subject to moderate change. However, to achieve the maximum profit, these flocks required more attention to sheep management. Choice of flock structure had a larger impact on profit than moderate changes in land allocation to cropping. Selection of the most profitable flock structure generated double the farm profit from that of the least profitable flock structure. More conservatively, a farm plan based on cropping and a self-replacing Merino flock using surplus ewes for first-cross, meat lamb production earned 33 per cent more profit than a farm plan based on a traditional self-replacing Merino flock that emphasised wool production. An additional feature of optimal farm plans was to commit to continuous pasture on all the poor soils whilst continuously cropping the more productive soils, with some complementary areas of permanent pasture. Allocating 40–60 per cent of the farm area to cropping was optimal, although this was affected by relative commodity prices.

Background/Intro

The strategic management of a mixed enterprise farm system is often a challenge. When completing a strategic analysis, the decision maker needs to consider the range of factors that can affect the relative profitability of each enterprise component, as well as how the components interact. A strategic question currently facing many mixed enterprise broadacre farm businesses in Australia is: What sheep flock size and structure is most profitable and complements the cropping components of the farm businesses? This is of importance to many farmers because of the high sheep meat and wool prices. Data from MLA shows the meat price for finished lamb in Western Australia is now 650 c/kg cwt (Meat and Livestock Australia, 2019) and data from AWEX shows the eastern market indicator for wool price is around 2000 c/kg clean (Australian Wool Exchange, 2019).

This research provides findings to help answer this question for a typical large mixed enterprise farm business in the south-west of the Western Australian Wheatbelt. Whole-farm bioeconomic modelling, combined with broad-ranging sensitivity analysis, was used to analyse the profitability of different sheep flock sizes and structures.

Methodology

The farm model employed in this analysis is known as MIDAS (Model of an Integrated Dryland Agricultural System), MIDAS is a whole farm linear programming model with a joint emphasis on biology and economics. The model's objective function is the maximisation of year-in-year-out (or steady state) farm profit, generated by selecting the optimal suite of activities whilst honouring constraints on resource availability.

For this analysis MIDAS input data was altered to represent the technical management and characteristics of the focus farm. These factors included mix of soils, land area, crop yield relativities, pasture production, sheep genotype and production, labour availability, machinery investment and work rates. This process of model construction and calibration occurred over several months in close collaboration with the farm manager, ensuring the model accurately portrayed the farm business.

The different flock structures (table 1) were compared at various price scenarios for meat, wool and grain (table 2 & 3).

Table 1: A description of the flock types included in this analysis.

Flock	Description
Store	A self-replacing Merino flock with emphasis on wool production. Wethers sold as store lambs to other farmers (6 months).
Export Wether (Shipper)	A self-replacing Merino flock with emphasis on wool production. Wethers sold as shippers (18 months or older)
Merino prime lamb (MPL)	A self-replacing Merino flock with emphasis on wool and meat production. Includes all other options above with the additional option of selling finished Merino lambs (10 months)
Trade wether	Buy in store wethers, sell as shippers (18 months or older). Emphasis on wool production.
Self-replacing crossbred lamb (SRF-MTS)	A self-replacing Merino flock utilizing surplus ewes (cast for age or surplus ewe hoggets) for 1st cross lamb production sold as suckers[1] (4.5 months). Merino wethers can be sold as Merino prime lamb or as shippers. Emphasis on meat and wool production.
Specialised crossbred lamb production (Specialist-MTS)	Replacement Merino ewes are bought in. All ewes are mated to produce 1st cross lambs sold as suckers[1] (4.5 months). Emphasis on meat and wool production
Composite	Composite ewes mated to composite rams to produce composite lambs. Wethers sold as suckers[1] (4 months) Emphasis on meat production.

[1] Lambs which are still dependent on their mothers for milk.

Table 2

Sheep sensitivity parameters in the analysis.

	Lamb ($/kg)[1]	Shipper ($/hd)	Ewes ($/hd)[2]	Wool (c/kg)[3]
High (+20%)	7.20	114	102	1800
Standard	6.00	95	85	1500
Low (-20%)	4.80	76	68	1200

[1] Merino prime lamb price. Wether lambs 6 months old sold to other grazier have a 37 c/kg discount and Crossbred lambs have a 20 c/kg premium.
[2] Price for a 5-year-old. 6-year-olds are discounted $15/hd and ewe hoggets have a $20/hd premium.
[3] Western market indicator price (c/kg) clean 21 micron wool.

Table 3

Grain prices used in sensitivity analysis.

	Wheat ($/t)	Barley ($/t)	Oats ($/t)	Canola ($/t)	Lupins ($/t)
High (+20%)	354	354	282	648	366
Standard	295	295	235	540	305
Low (-20%)	236	236	188	432	244

Findings

Flock structure

Whole farm profitability varied by $630 000 per year between the least and most profitable flock structures evaluated (Fig. 1), illustrating the importance of flock selection for mixed farm businesses. The most profitable structure was the Specialist-MTS flock turning off first cross finished lambs. This is because these flocks produced large amounts of high quality wool from the Merino ewes whilst also turning off large quantities of high quality finished lamb. However, to achieve high profit levels these flocks required a higher level of management skills because they are run at higher stocking rates and have greater sensitivity to weaning weights. Running higher stocking rates and maintaining sufficient weaning weights requires appropriate ewe management and feed allocation.

The findings in this study are consistent with the general trend observed in Western Australia and many other sheep producing regions of Australia, where the number of retained wethers relative to ewes is decreasing. Currently wethers only make up 11% of the national sheep flock (ABARES, 2018). Additionally the proportion of ewes joined to terminal sires is

increasing (Perrett, 2015). This provides confidence that the industry is moving in the correct direction.

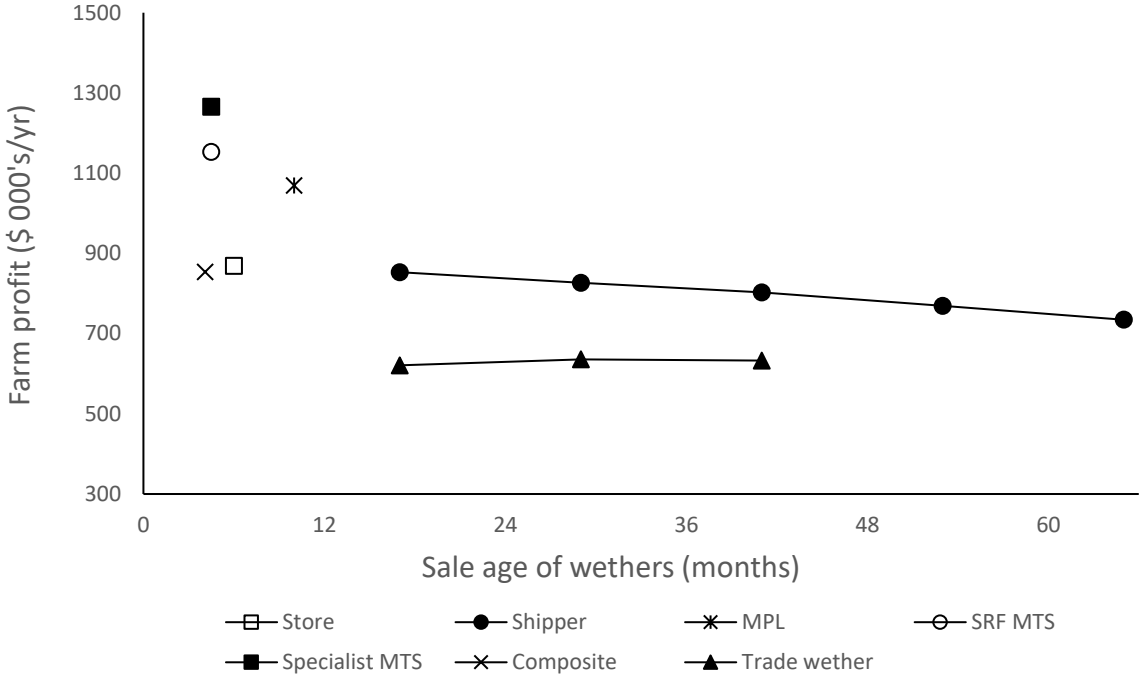

Fig. 1. Whole farm profit for each of the flock structures evaluated in this analysis.

Crop and livestock integration

The optimal cropping proportion for the focus farm is between 40%-50%, although cropping proportions as low as 20% and as high as 80% are still economically viable. Within 30% to 70% cropping, farm profit is affected more by selecting the optimal flock than altering crop allocation (Fig. 2). Thus, farmers should first focus on implementing the optimal flock structure before making changes to their cropping allocation. However, if farmers are satisfied with their flock structure, profit can be increased by shifting their crop allocation to between 40% - 50%. This is lower than the current average in the south west region of Western Australia, which is on average cropping 64% of agricultural land (ABARES, 2017). Reducing the proportion of the farm in crop from 60% to 50% increases farm profits by up to $45 000. Additionally, selecting the correct rotation for each soil type is important. Selecting the wrong rotation can reduce profits by up to $170/ha. It is most profitable to have continuous pasture on the less productive soils and continuous crop on the more productive soils.

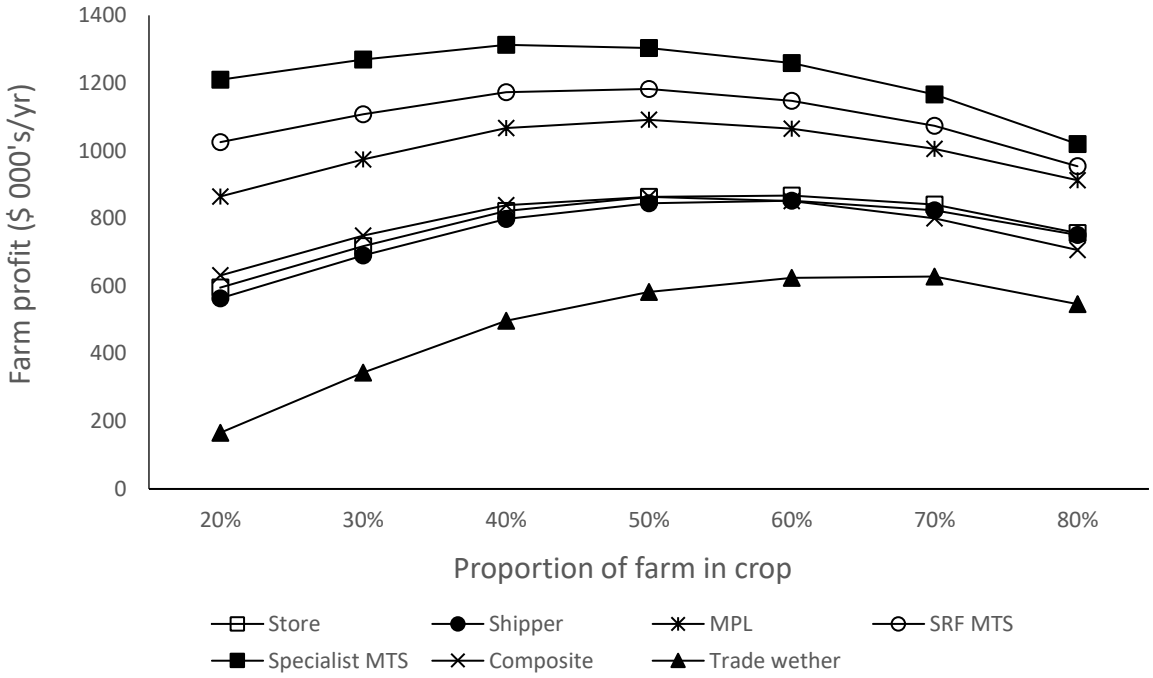

Fig. 2. Farm profit curve for each flock structure option over a range of cropping proportions.

Price sensitivity

Increasing the meat price increases the relative profit of flocks turning off finished lambs and decreasing the meat price decreases the relative profit of flocks turning off finished lambs. In contrast, increasing the wool price increases the relative profit of the flocks retaining wethers and decreasing the wool price reduces the relative profit of retaining wethers. Hence, flocks that produce a balanced mix of both wool and meat are less sensitive to changes in either wool or meat prices. Price variation has the greatest impact on the profitability of flocks based on a composite genotype (meat emphasis) and merino flocks selling wethers as shipper (wool emphasis). However, optimal flock structure choice remains robust to price changes as large as 20% (Fig. 3 and Fig. 4). This can provide farmers with confident with their choice of flock structure in the face of market uncertainty.

Grain is a major input for the sheep enterprise whilst being the key output of the cropping enterprise. A 20% increase in grain price shifts the optimal cropping proportion towards 70% and increases farm profit by up to 18%. Even with the increase in grain price (supplement cost) it is still optimal turn off finished (Fig. 5). A 20% decrease in grain price reduces the farm profit and optimal crop allocation because of the access to cheaper

supplementary feed. Again, however a 20% change in grain price either way doesn't alter the optimal flock structure.

*note: The profits presented in the results below are presented relative to the profit of the shipping flock selling wethers at 17 months old. Relative profit was calculated to remove the impact of price changes on absolute profit levels, to highlight the differential impact of price changes between flocks.

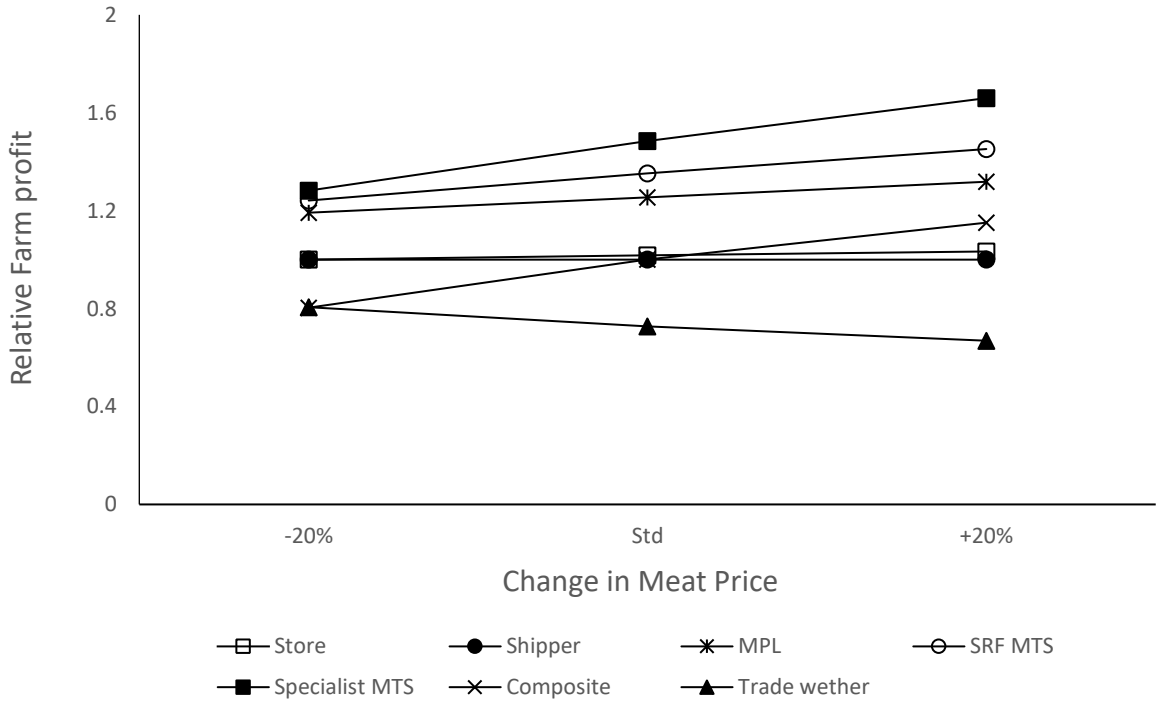

Fig. 3. Farm profit for each flock structure relative to the shipper flock selling at 17 mo (whole farm profit of a given flock divided by whole farm profit of shipper flock), when the meat price is reduced by 20%, standard and increased by 20%.

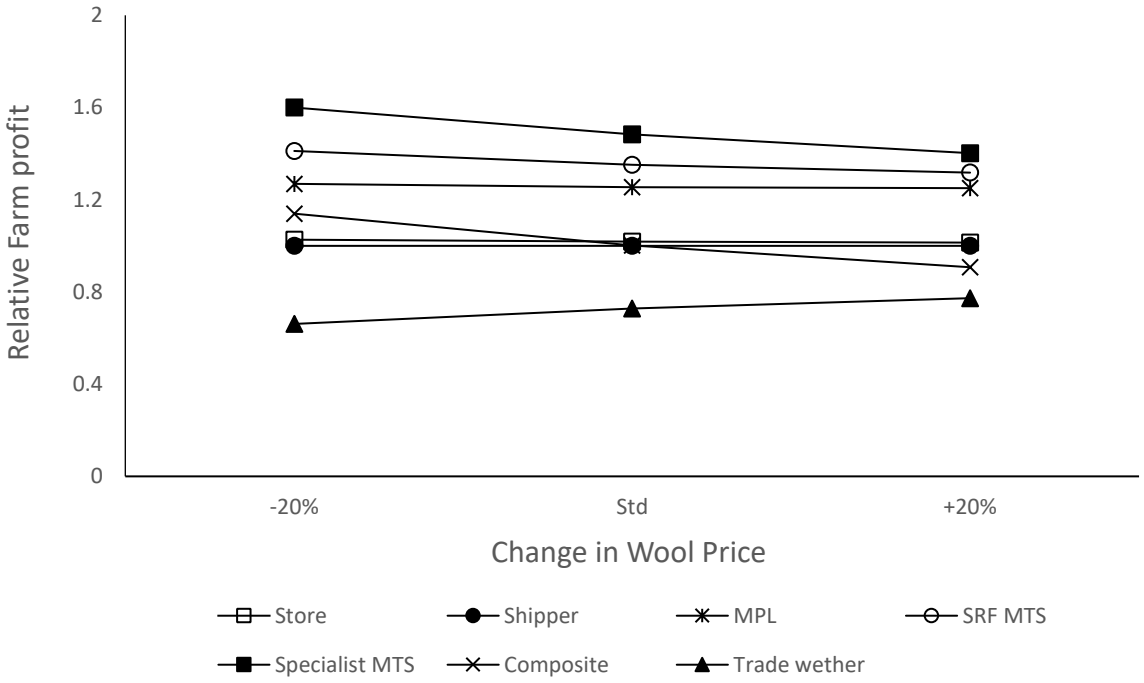

Fig. 4. Farm profit for each flock structure relative to the shipper flock selling at 17 mo (whole farm profit of a given flock divided by whole farm profit of shipper flock), when the wool price is reduced by 20%, standard and increased by 20%.

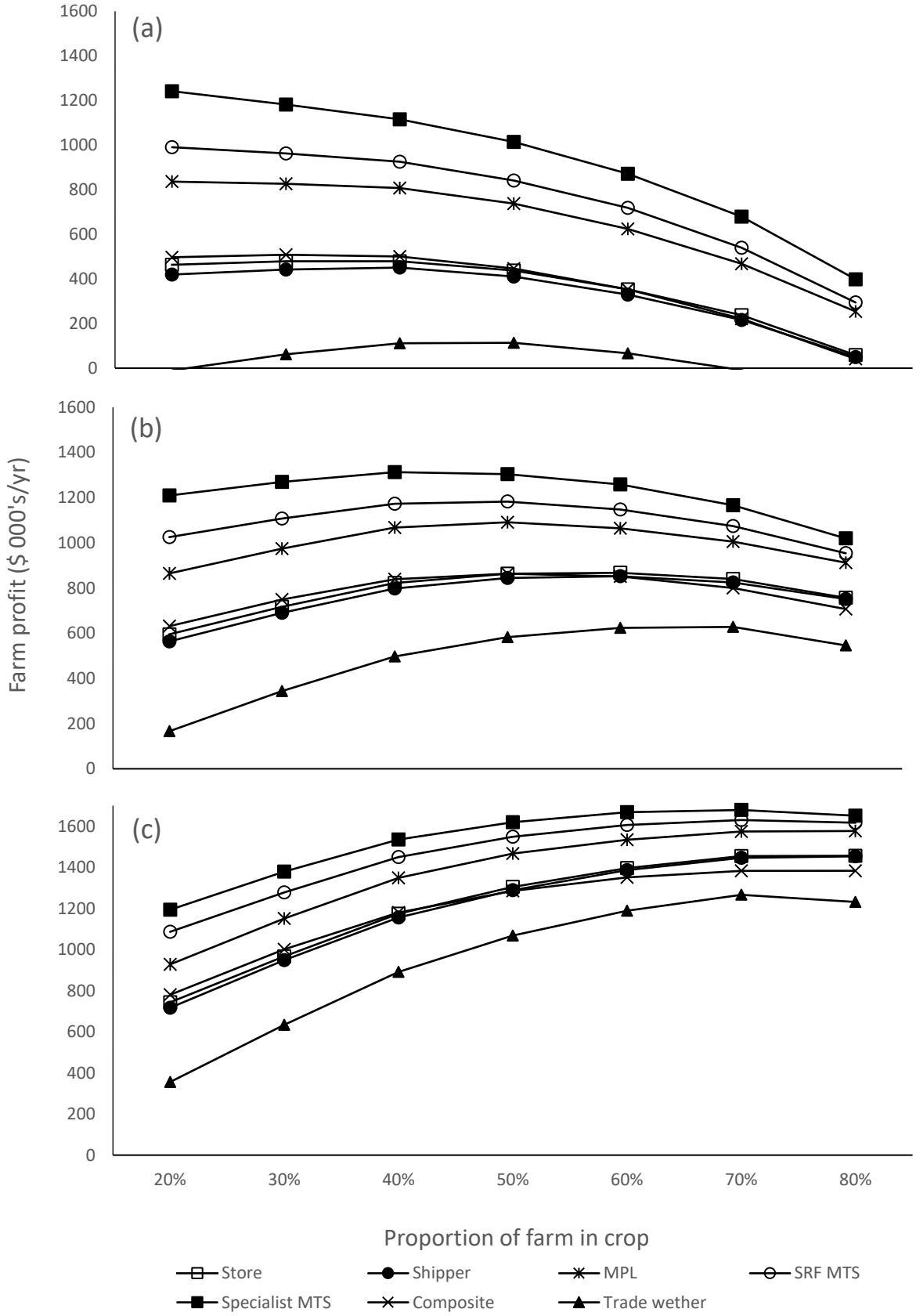

Fig. 5. Farm profit for each flock structure at a range of cropping proportions when grain price is altered. (a) – grain price reduced by 20%, (b) – grain price standard, (c) – grain price increased by 20%.

Conclusion

This analysis illustrates that flock structure, rotation and crop allocation are all factors that have a significant impact on profit and need to be considered when determining farm strategy. The analysis in this study also indicates that it is most profitable to run a Specialist-MTS flock. However, all three Merino flocks turning off finished lambs were very profitable. These flocks remain most profitable if key input prices and commodity prices change. However, to achieve the maximum profit, these flocks require more attention to sheep management. Furthermore, a feature of the optimal farm strategy was to commit to continuous pasture on the poor soils and continuous crop on the more productive soils. Finally, it was found that allocating 40% - 50% of the farm to cropping was optimal, although this was affected by relative commodity prices.

The results from the research concur with the currently observed direction of the industry regarding flock structure, although the industry could increase profits by reducing the level of cropping and increasing flock size.