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Are heavy lambs economically sensible?

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Abstract

Current pricing signals for lamb are encouraging the supply of lambs at heavier weights. However, for Australian producers who lotfeed lambs, the decision to target the heavier end of the market specification is not clear cut. Variables such as growth rate, feed costs and store lamb purchase price, as well as sale price, all have an influence on the profit margin of feeding lambs to a range of carcase weights. Using a deterministic model and a partial-factorial experimental design, a series of sensitivity analyses were conducted to assess these relationships. The results showed that in certain conditions, targeting a heavy lamb specification was an economically sensible decision. When sale prices were at least ten per cent higher than the average it was a profitable thing to do. When sale prices were average or low, if at least one other cost variable was low, it was similarly a sensible decision. With volatile pricing across all variables and potentially tightening market specifications, the results of this analysis will play an important role in helping lamb producers determine whether it is worthwhile targeting a heavier weight.

Keywords: lamb lotfeeding, market specifications, sensitivity analysis, lamb price.

Introduction

High lamb prices and broad weight-based pricing specifications with few price penalties based on fat depth are encouraging some producers to feed lambs to a heavy weight market specification, despite customers demanding more moderate carcase weights. Lotfeeding lambs to meet a heavy carcase weight specification can be costly, which combined with variable feed costs and growth rates, and potentially tightening price premiums, motivates the need for this study.

This study sought to establish whether it was economically sensible for lamb feedlot operators to target selling heavy lambs over the hooks, given the current lamb market's pricing signal. A review of the literature and current media around lamb pricing signals, some simple economic modelling and a consideration of factors that may influence this decision in the future are used to address the question: "is finishing lambs to target heavy carcase weights an economically sensible practice?"

Background

Lamb carcase weights have increased substantially over recent years. Saleyard lambs over 22 kg carcase weight have increased from 18 per cent of throughput in 2000 to 48 per cent in 2017 (Meat and Livestock Australia, 2018a). The composition of the heavy weight category has been transformed, with carcases over 26 kg making up 14 per cent of production in 2017-18, while in 2000 the percentage of Australian slaughtered lambs that were over 26 kg was negligible (Meat and Livestock Australia, 2018b). Projections suggest that by 2022, average carcase weights will have increased a further 3 per cent from 2017, from 22.7 kg to 23.3 kg (Meat and Livestock Australia, 2018c).

In comparison, the ideal domestic lamb specification for consumers is judged to be around 22 kg (AWSA, 2013; Woolworths Group, 2018; Meat and Livestock Australia, 2017). The domestic market absorbs approximately 40 per cent of lamb supply. In the export market, heavier carcase weights intended for the United States, a market that takes 22 per cent of Australia's export lamb supply, range from 20 to 30 kg, although one processor suggested recently that the true maximum weight specification for that market is around 26 kg (Meat and Livestock Australia, 2017; Australian Wool Innovation & Meat and Livestock Australia, 2008; Sim, 2017). Consumers appear to demand mid-weight lambs, however this ideal is not matched by the increasing lamb carcase weights. Given the increased average carcase weight, the Australian lamb industry cannot meet market requirements that require a lighter weight carcase, resulting in processing losses associated with over-fat lambs and additional trimming. This inefficiency leads to the industry "potentially missing out on tens of millions of dollars annual profit" (Meat and Livestock Australia, 2018b, p.1).

A cause of this mismatch between production and customer requirements is the pricing signals offered by processors to producers (Meat and Livestock Australia, 2018c). Many Australian lamb processors have recently been offering a very wide pricing grid "sweet spot", the highest priced specification of their purchasing offer (see Figure 1, Meat and Livestock Australia, 2018c). The "sweet spot" is intended to target supply to a key specification, set to meet the market that the processor is supplying (e.g. a domestic supermarket requiring a 20-24 kg carcase). However, the discount associated with exceeding the maximum specification of the "sweet spot" is often minimal, meaning that suppliers are little concerned about lambs falling out of the consumer's ideal specification by being too heavy. They can still achieve strong prices (Marriott, H, pers. comm., 2 February 2018). This leads many producers to target the heavier end of the specification, as, by doing this, they may achieve the highest price per head for their lambs (Sim, 2017). A possible negative associated with producers targeting the heavier end of a weight-based pricing system is that, in the absence of a penalty for fat score (which in many cases these open grids do not have), slaughter lambs have a higher percentage of fat that is ultimately being trimmed off the carcase, causing a significant inefficiency. By using a wide weight-based pricing grid to attract optimal slaughter numbers, processors might in fact be encouraging their supplying producers to provide lambs at much heavier weights than the end-customer desires.

Figure 1. Excerpt from Thomas Foods International Lobethal Lamb pricing grid, 13 August 2018

XB Lambs			Grade Price / HSCW Range									
Grade	Fat mm	-14	14.1-16.0	16.1-18.0	18.1-20.0	20.1-22.0	22.1-24.0	24.1-26.0	26.1-28.0	28.1-30.0	30.1-32.0	32.1+
S1	0 - 5	$2.60	$3.60	$5.90	$7.20	$7.20	$7.20	$7.20	$7.20	$7.20	$7.20	$6.70
S2	6 - 10	$2.90	$3.90	$6.20	$7.50	$7.50	$7.50	$7.50	$7.50	$7.50	$7.50	$7.00
S3	11- 15	$2.90	$3.90	$6.20	$7.50	$7.50	$7.50	$7.50	$7.50	$7.50	$7.50	$7.00
S4	16- 20	$2.90	$3.90	$6.20	$7.50	$7.50	$7.50	$7.50	$7.50	$7.50	$7.50	$7.00
S5	20+	$2.90	$3.90	$6.20	$7.50	$7.50	$7.50	$7.50	$7.50	$7.50	$7.50	$7.00

Source: Thomas Foods International (2018). Note: The yellow highlights the ideal specification.

Some producers lotfeed lambs to achieve the heavier weights encouraged by the pricing signals. While there are specialist lamb finishers, in dry or over-wet seasonal conditions or when market prices are tempting, other producers may use supplementary feeding of lambs to finish them.

Whether it is an intentional business strategy or a response to seasonal or market conditions, the supplementary or lot feeding of lambs to meet a heavy carcase weight specification can be costly (Productive Nutrition Pty Ltd, 2011). Put simply, the lack of clear, accurate market signals is leading many producers to grow heavier, potentially fatter, more costly lambs than required by the supply chain.

Given the current lack of accurate pricing and market signals, it is worth examining whether it is profitable to feed lambs to a heavy weight and therefore receive a higher price from the meat processor.

Aim and Objectives

This study was designed to establish whether it is economically sensible for lamb feedlot operators to produce and sell heavy lambs over the hooks, given the current lamb market's price signals for heavy lambs. The specific objectives of the study were to:

- Evaluate through research literature and current media reports how pricing signals influence supplier behaviour, including how pricing grids operate, in the context of a lamb feedlot.
- Using a modelled lamb feedlot operation, measure the cost of carcase weight production in heavy lambs at a range of weights, including a sensitivity analysis for a range of feed-cost and growth-rate scenarios.
- Using the modelled feedlot operation, measure the income generated from these heavy lambs, given a current lamb pricing grid. Test this income in a range of pricing scenarios, including a "tighter" grid with stronger pricing signals.
- Using these findings, identify key cost- and price-pressure points that may limit a producer's profitability when targeting a heavy weight lamb market.
- Describe potential factors that may influence a producer's decision to target a heavy weight lamb market, for example growth rate and maturity path of the lambs.
- Identify at what point, including pricing signals and feed costs, is it economically sensible for a lotfeeder to target a heavy lamb market specification.

Literature Review

The research question focusses on two key areas: 1) pricing signals in the heavy lamb market, along with costs associated with non-compliance to specifications; and 2) the economics of feeding lambs to a heavy weight in a feedlot scenario.

This literature review explores the existing research around these two areas, along with defining the terms and concepts used within this study. The review establishes key figures to be used in modelling, provides a grounding in the current market context and identifies gaps in the current literature that are addressed in the analysis.

Pricing signals in the heavy export lamb market

Market signals and supply response. A market signal is the information provided by a customer to the supplier. It indicates the demand in the market for a particular product. This signal often takes the form of a price for a product or specification, with changes in the price indicating an incentive to generate increased or decreased supply (Outlaw, Anderson & Padberg, 1997). The response of suppliers to a change in pricing has been the subject of many studies (Diebold & Lamb, 1997; Rao, 1989; Reutlinger, 1966; Whipple & Menkhaus, 1989). Supply response can be estimated using the concept of the elasticity of supply. Research into supply responses in Australian agriculture has consistently shown that sheep supply is inelastic in the short-to-medium term in response to prices, as a result of limited flexibility to adjust livestock numbers (Griffith et al., 2001; Mullen & Alston, 1994). In the longer term, changes are possible and more likely to occur in line with breeding cycles (Outlaw, Anderson & Padberg, 1997). Two decades ago it was found that there was a price incentive to supply lambs at certain fat specifications, but that pricing differentials for weight of the lambs were difficult to discern (Mullen, 1995). In contrast, by 2009, a further study found that there were several clear weight specifications that attracted premium prices, including a trade weight 18-20 kg specification and a significant premium for the heaviest lambs consigned over the hooks, although the study did not identify how heavy these lambs were (Hufton et al., 2009). The pricing premiums or discounts linked to specifications may provide an incentive to supply lambs to different specifications. Little research has examined the actual difference in intention to supply lamb to an 18-22 kg specification as opposed to a 26-32 kg specification linked to prices.

This research gap is focussed on in the context of intensive lamb production, such as in a feedlot operation. Many lamb feeding systems operate within a larger, diverse agricultural business, and so operators may decide to feed lambs on an opportunistic basis (Spencer & Whitehall Associates, 2004). Lambs from a breeding operation can be sold at almost any age, either to lotfeeders, restockers, or to processors at a range of weights (Australian Wool Innovation & Meat and Livestock Australia, 2008). This range of output sale options increases the complexity of establishing a supply-response relationship. Additionally, all management and marketing decisions will be influenced by input costs. While supply-response relationships in the sheep-meat industry have been established, there is a dearth of published research into the potentially different intermediate supply-response relationship between intensive lamb feeding and prices.

Pricing grids and specifications. Of the range of marketing options available to producers selling lambs for processing, the two most commonly used are saleyard markets and direct-to-processor sold on a carcase weight basis, or over-the-hooks (OTH) (Spencer & Whitehall Associates, 2004). In a recent review of the market structure of the sheep industry, Herrmann, Dalgleish and Agar (2017) found that saleyard prices led OTH prices by approximately three weeks. Since processors absorb approximately 80 per cent of saleyard throughput (in the Eastern states), they actively set the specifications required for their own markets (Herrmann, Dalgleish & Agar, 2017).

In OTH sales, a price grid is used to determine the value of each carcase, as well as signal the desired carcase attributes for that period. The pricing grid is set by individual processors, based on their own requirements for their customers, and includes carcase attributes such as carcase weight and fat measurement. Grids also are differentiated by the age of the lamb or sheep, the breed, whether it is weaned or unweaned, Meat Standards Australia (MSA) eligibility and export status. In forward-priced grids, a delivery date may also influence the price received. A price is set for the most desirable combination of traits, with discounts applied for less desirable attributes. An example of a grid from the beef industry is shown in Table 1. The ideal specification is highlighted in yellow. Incorporating a greater variation in price based on carcase weight and fat, this grid is aimed at achieving a preferred carcase compared to the lamb price grid shown in Figure 1.

Pricing grids contain valuable market information for the producer: grid pricing "is believed to improve the transmission of information and incentives to the producer" (Johnson & Ward, 2006, p.78). The signalling provided by the grid should allow producers to understand the desired specification by the processor, and by linking non-compliance to a discounted price per kilogram for that carcase, to provide an economic incentive or disincentive to meet that specification.

Table 1. Excerpt from JBS beef pricing grid, 23 July 2013

Grade	Fat	Teeth	Shape	Price							
MSA Grass Trade Yearling Steer				**360+**	**340+**	**320+**	**300+**	**280+**	**260+**	**240+**	**220+**
MYO	5-22	0-2	A-C		3.55	3.65	3.65	3.65	3.55	3.50	
MY1	23-32	0-2	A-C		3.50	3.60	3.60	3.60	3.50	3.45	
MY2	5-22	0-2	A-D		3.45	3.55	3.55	3.55	3.45	3.40	
MY3	23-32	0-2	A-D		3.35	3.45	3.45	3.45	3.35	3.30	

Source: JBS Australia (2013). Note: The yellow highlights the "sweet spot" in the specification.

Using the American beef industry as an example, Outlaw et al. (1997) explain how a pricing signal might be interpreted and acted upon by the supply chain:

> Take, for example, consumers" desire for leaner beef. This message is communicated through retail demand to [processors] who, in turn, bid the price of fed cattle that are not over-finished to a relative premium compared to over-finished cattle. Cattle feeders then may pay a premium for the type (size and/or breeds) of feeder cattle that produce leaner meat or finish cattle to Select instead of Choice grade. Hopefully, then, this information may be passed on to producers in the form of premiums (discounts) for calves of the desired (undesired) breed. Producers can then react to this price signal by purchasing breeding stock of the desired breed. This example, although fairly simple, serves to illustrate how the demand for measurable or distinguishable traits may be signalled throughout the production system (Outlaw, Anderson & Padberg 1997, p.42).

This example raises questions about what traits consumers demand in lamb. Do the pricing signals offered accurately reflect the attributes required by customers?

Restricted supply of lambs in conjunction with growing demand for lamb, particularly in export markets, has caused processors to loosen their specifications to ensure consistent supply (Sim, 2017). This has meant that a "flat" grid has developed. This flat grid has become a representation of the modern Australian lamb market. Many OTH grid offerings have flat pricing for a broad grid, regardless of the end market. For example, major meat company JBS Australia released a grid in 2017 that had a flat price for lambs between 18 and 32 kg carcase weight, with a 50c per kilogram discount for lambs above 32 kg with no upper limit (JBS Australia, 2017). A second major lamb processor, Thomas Foods International, maintained a similar pricing structure (Figure 1). These broad specifications were in direct contradiction to a major company spokesman, who at the same time reported that even their heaviest market had an ideal carcase weight of 26 kg, and that 40 per cent of their current lamb supplies did not fit their customers' specifications (Sim, 2017). The processor spokesman acknowledged that the broad, flat grid encouraged producers to "produce something that is as heavy as possible, because dollars per head is where you get your best money" (Sim 2017, p.1). This disconnect between supply and what the consumer wants has been highlighted as a key issue for the lamb industry in recent years (Sheep CRC, 2016).

Compliance to specifications. This imprecise market signal from the flat grid leads to a substantial proportion of lambs that are "too heavy and too fat" for their target markets (Sim, 2017, p.1). An example of a "flat" pricing grid is shown above in Figure 1. There is no price difference for lambs between 18 and 32 kg carcase weight. The broad, flat-priced grid means that there are few penalties for supplying outside of the ideal consumer specification, or "sweet spot", and therefore little incentive to be compliant to a tighter market requirement (Sim, 2017). Indeed, anecdotally some producers aim for the "top" of the specification, with the acknowledgement that even if their lambs are too heavy for the sweet spot, the discount applied is often so minimal that it makes little difference economically (Marriott, H., pers. comm., 2 February 2018). In addition to the broad weight specification, fat measurements have been almost forgotten, with many producers finding that during periods of peak demand there is little disadvantage for lambs that are over-fat (Dowler, 2017; Herrmann, Dalgleish & Agar, 2017). In Figure 1, there is no price difference for lambs with more than 5mm fat.

Possibly because of the unclear market signals, few studies have examined market specifications in lamb, or the economics of meeting target specifications in lambs. Processors occasionally report non-compliance figures (e.g. JBS in Sim, 2017); however at an industry level, compliance figures have not been released since the mid-2000s (Linden, N., pers. comm., 21 May 2019). Formal research on this topic is scarce.

Feeding lambs

Who feeds lambs? Traditionally, producers were constrained by local seasonal conditions and management preferences for certain – typically lighter-weight – product specifications. This is still the case in many parts of Australia. However, since the 1990s interest has been growing in specialist lamb feeding operations (Spencer & Whitehall Associates, 2004). By 2005-6, 9.2 per cent of the annual turn-off of lambs were expected to be sold out of a feedlot (Giason & Wallace, 2006). Many of these feedlot systems are integrated in larger breeding and occasionally cropping enterprises and are a smaller component of the whole business (Herrmann, Dalgleish & Agar, 2017).

In recent years, many producers have also built "drought lots" or stock containment areas, primarily intended to be used to manage feeding of sheep off-pasture, for example to protect paddocks during adverse seasonal conditions (Meat and Livestock Australia, 2016). These stock containment areas have also added flexibility to producers' marketing decisions: they now have the infrastructure in place to opportunity feed lambs outside of the traditional pasture-based season to meet specific market specifications (Roberts & Curnow, 2018). This suggests that when the market is encouraging the production of heavy lambs (through higher prices), producers increasingly have the capacity to meet that market in a shorter time-frame than previously.

Determinants of profitability in feeding lambs. There is a plethora of industry and producer-led research into the key drivers of profitability in prime lamb production, including in grain-fed lambs. Across these studies, certain traits regularly appear: growth rates, feed conversion efficiency and animal health/mortality rates to name but a few. A summary can be found in Table 2.

It is worth mentioning that while several studies (Duddy, 2017; Male, 2012; Productive Nutrition Pty Ltd, 2011) do not explicitly mention "growth rates", factors mentioned such as the "ideal lamb" (Male, 2012) and "throughput" are influenced by favourable growth rates of the lambs.

Growth rates and feed efficiency. A key determinant of productivity in lotfeeding lambs is their growth rates and the interaction between feed consumed and weight gained, also known as feed efficiency. While Meat Standards Australia suggest that eating-quality in lambs is compromised with growth rates less than 100 grams/day for the two weeks prior to slaughter, the minimum growth rates required of lambs on feed to be considered profitable is above 300 grams/day (Meat and Livestock Australia, 2007, 2006). Recent research has shown growth rates in a single line of older lambs in a feedlot scenario can range from less than 100 grams/day to over 400 grams/day, supporting the maxim that there is often more variation within a breed type than between breeds (Ritchie, 2018).

As with growth rates, feed conversion ratios (FCR) can vary enormously, with Victorian research finding FCR can vary between 2.5:1 and 12:1 in fed lambs (McNaughton, 2009). A 2006 survey found that most lamb feedlots reported FCRs between 5:1 and 7:1, although anecdotal evidence is mentioned that significantly better FCRs have been seen by some lotfeeders (Giason & Wallace, 2006).

Table 2. Summary of key research into drivers of profitability of sheep feedlots

Year	Researcher(s)	Publication	Key drivers
2005	Dowdy, J	Maximising profitability of lamb finishing systems	Stock health Feed quality Feed conversion efficiency Growth rates
2007	Meat and Livestock Australia	A producer's guide to production feeding for lamb growth	Price margin Ration cost Growth rate Time on feed Mortalities/poor performers
2007	Jolly and Wallace	Best practice for production feeding of lambs: a review of the literature	Growth rates
2011	Productive Nutrition Pty Ltd	Prime lamb finishing options: Key profit drivers for a range of finishing systems	Purchase price Growth rate Carcase price Scale of operation Shy feeders Mortality rate
2012	Male, J	Lamb finishing systems: maximising the margins on grain finishing lambs	Purchase price Feed type/price Ideal lamb
2017	Duddy, G	Investor ready sheep feedlot project	Value of restocker/feeder lambs relative to finished lambs Throughput Timing of purchase and marketing

Sources: Dowdy (2005), Meat and Livestock Australia (2007), Jolly & Wallace (2007), Productive Nutrition Pty Ltd (2011), Male (2012), Duddy (2017)

Linden's Lamb Energetics (2011) and his follow-up Red Meat Energetics (2015) studies investigated phenotypic and genotypic factors that impacted the finishing efficiency of lambs, with findings identifying some key factors that may impact growth in finishing. Nutritional restriction pre-weaning, the genetic influence of the sire and the age of lamb at feedlot entry all had impacts on feed efficiency and growth rates in lambs (Linden, 2011).

The 2015 study also noted that while FCR has been investigated, very few researchers have examined Residual Feed Intake (RFI), whereby the measure of feed efficiency is independent of, as opposed to correlated to, growth rates (Linden, 2015). This is a gap in the research: without understanding the RFI, actual feed intake linked to both maintenance and growth cannot be calculated. While some RFI research has been conducted on adult ewes, further research will be key to understanding the relationship between genetics, environmental factors, feed intake and growth in lambs in the future (Muir et al., 2018).

Male (2012) and Linden (2011) both report that a strong relationship exists between genetic breeding values and growth rates in lambs on feed, building on research undertaken by the Sheep CRC, leading to Australian Sheep Breeding Values (ASBVs). There are a range of ASBVs to increase growth rates in lambs and, there is little doubt that adoption of higher growth rate ASBVs in sheep has played a significant part in lamb carcases now being heavier than ever before (Meat and Livestock Australia, 2018b; Sheep CRC, 2016).

The variability of growth rates and feed efficiency play a key role in the potential profitability of a feedlot operation, particularly when producing heavy weight lambs for export.

Cost of Production. For slaughter lamb production, especially via feedlots, the crucial factors include costs associated with purchasing stock, including analysing potential opportunity cost if feeder lambs are bred on the property (Male, 2012). Feed costs and ensuring feed meets the nutritional requirements of the lambs are also fundamental to the cost of production (Male, 2012). Based on national survey data, ABARES reports that at a whole-farm level, variable costs were also influenced by crop and pasture chemicals, fertiliser, fodder, fuel, repairs and maintenance, contracts paid, veterinary and livestock materials and labour costs (ABARES, 2018). While some of these factors are relevant to the lamb feedlot enterprise (e.g. fodder, repairs and maintenance of feeding equipment, labour) a gross margin or partial budget of the feedlot enterprise on its own will not necessarily include the full list proposed by ABARES.

Literature review summary

Clear pricing signals that meet customer requirements are not apparent in the lamb industry at present. The current market is characterised by a "flat" grid with little incentive for a producer to deliver lambs at a particular weight within the specification, especially at weights at the lower end of the range. Indeed, the pricing signal is encouraging producers to aim for heavier weight lambs as they earn more money per head, disregarding potentially higher production costs, which creates a mismatch for processors between their supply and their own customers.

In addition to the market signal, there are other significant determinants of profitability that must be considered by producers wishing to target that market. Key to the profitability is the growth rate of the lambs. While true feed efficiency (including RFI) data are lacking, it is acknowledged that the growth rate of the lambs, purchase cost of the lambs, cost of feed and selling price are all essential components of the profitability of a feedlot. Time on feed and throughput of the enterprise are also key profit drivers that rely on growth rates. The interaction between variable growth rates of lambs, variable costs and the profitability of targeting a heavy export market has not been previously examined.

Model

A deterministic model was developed, using a range of simulated strategies (in this case, to achieve intended carcase weights) with an optimisation overlay, to determine which strategy provided the best outcome given the variables in question. Sensitivity analyses are a useful tool in farm business management decision-making, allowing for simple analysis of the influence of variables on output (DairyNZ, 2018). Indeed, simple sensitivity analyses "may even be the absolute best method for the purpose of practical decision making" (Pannell, 1997, p.151).

A partial-factorial experimental design was implemented, where the model was solved for most possible combinations of the parameters (exclusions being growth rate for the first four tests, and store lamb cost for the fifth test). This experimental design was selected as it provides a wealth of information while still producing a dataset that is manageable and efficient (Pannell, 1997). An example of the model can be found in Appendix 1.

The variables explored were:

- Store lamb cost, also known as restocker lamb cost,
- Feed cost,
- Sale price received for finished lambs,

- The type of grid pricing structure,
- Growth rate of the lambs, and
- Lamb carcase weight.

These key variables were tested in a series of sensitivity analyses to establish their impact on a basic profit margin.

Five key relationships were tested:

- Cost of production sensitivity, consisting of three store lamb prices, three feed prices, and six weight brackets.
- Income sensitivity, consisting of three sale prices across six weight brackets, in two different grid structures.
- Flat-grid profit margin sensitivity, based on the nine cost of production scenarios (store lamb and feed costs combined), six weight brackets and three sale prices on a flat grid.
- Tight-grid profit margin sensitivity, based on the nine cost of production scenarios, six weight brackets and three sale prices on a tight grid.
- Growth rate impact on profit margin sensitivity, consisting of three growth rates, three feed prices, six weight brackets and three sale prices on a flat grid, with an average store lamb price.

Given the scope of the project is modelling a lamb feedlot that has already committed to feeding lambs, this project does not consider general costs of running a feedlot, including depreciation of assets, infrastructure costs, labour and veterinary/medical costs that would be present regardless of the weight specification targeted.

The model assumes purchasing lambs at 36 kg live weight, equivalent to approximately 17 kg carcase weight (cwt). Feed costs are based on a good quality grain-based finisher ration. Feed conversion ratios are assumed to be 6:1 (for every 6 kg of feed, 1 kg of live weight is added (Duddy et al., 2016; Linden, 2015)) unless otherwise mentioned, for example in the growth rate sensitivity test. No fat specifications were examined, reflecting the current market conditions where fat is not a defining feature of specifications (Dowler, 2017; Herrmann, Dalgleish & Agar, 2017).

Baseline data

Baseline data for establishing cost of production can be found using existing industry extension materials (Duddy et al., 2016; Meat and Livestock Australia, 2007; Agriculture Victoria, 2015; Brown, 2018). These resources enable estimates of feed requirements and basic cost of production elements to be established. Estimates of reasonable costs of feed, store lambs and grid prices are collected from industry reporting services (Dairy Australia, 2018a, 2018b; Meat and Livestock Australia, 2018d) (Table 3). Averages are established over the twelve months to October 2018, variation is set at 10 per cent for livestock prices and at 25 per cent for feed costs, due to their highly variable nature (Meat and Livestock Australia, 2018e).

Grids offered by Thomas Foods International (2018) were used to establish a current “flat” pricing structure (Table 4). A modified version considering the tighter specifications desired, but not currently signalled by processors, is shown in Table 5 to demonstrate the impact that tightening specifications may have on the profitability of feeding lambs to heavier weights (Sim, 2017).

In addition to the average prices, based on the previous year’s data, a low and high cost for both feed costs and store lamb costs is included in the analysis. This creates nine separate cost-of-production models (Table 6).

Table 3. Baseline data for variables in sensitivity analyses

Variable	Low	Average	High	Variation
Store / restocker lamb cost	563 c/kg	626 c/kg	689 c/kg	10%
Feed cost	$300/tonne	$400/tonne	$500/tonne	25%
Sale price (OTH)	585 c/kg	650 c/kg	715 c/kg	10%

Sources: Meat and Livestock Australia (2018d), Dairy Australia (2018a, 2018b)

Table 4. "Flat" pricing grid, where X is the base price (c/kg cwt)

		HSCW kg										
		0-14	**14.1-16.0**	**16.1-18.0**	**18.1-20.0**	**20.1-22.0**	**22.1-24.0**	**24.1-26.0**	**26.1-28.0**	**28.1-30.0**	**30.1-32.0**	**32.1+**
GR Fat mm	**0-5**	-400	-330	-160	-30	-30	-30	-30	-30	-30	-30	-80
	6-10	-370	-300	-130	X	X	X	X	X	X	X	-50
	11-15	-370	-300	-130	X	X	X	X	X	X	X	-50
	16-20	-370	-300	-130	X	X	X	X	X	X	X	-50
	20+	-370	-300	-130	X	X	X	X	X	X	X	-50

Source: based on a recent Thomas Foods International grid (Thomas Foods International, 2018)

Table 5. "Tight" pricing grid, where X is the base price (c/kg cwt)

		HSCW kg										
		0-14	**14.1-16.0**	**16.1-18.0**	**18.1-20.0**	**20.1-22.0**	**22.1-24.0**	**24.1-26.0**	**26.1-28.0**	**28.1-30.0**	**30.1-32.0**	**32.1+**
GR Fat mm	**0-5**	-400	-330	-160	-30	-30	-30	-30	-30	-80	-130	-230
	6-10	-370	-300	-130	X	X	X	X	X	-50	-100	-200
	11-15	-370	-300	-130	X	X	X	X	X	-50	-100	-200
	16-20	-370	-300	-130	X	X	X	X	X	-50	-100	-200
	20+	-370	-300	-130	X	X	X	X	X	-50	-100	-200

Table 6. Cost scenarios

Scenario	Store lamb cost category	Feed cost category
1	Low – 563 c/kg cwt	Low - $300/t
2	Low – 563 c/kg cwt	Average - $400/t
3	Low – 563 c/kg cwt	High - $500/t
4	Average – 626 c/kg cwt	Low - $300/t
5	Average – 626 c/kg cwt	Average - $400/t
6	Average – 626 c/kg cwt	High - $500/t
7	High – 689 c/kg cwt	Low - $300/t
8	High – 689 c/kg cwt	Average - $400/t
9	High – 689 c/kg cwt	High - $500/t

Results

Cost of production sensitivity analysis

The combined feed and store-lamb costs have been calculated for a range of weights (Table 7). The analysis uses the difference in expected carcase weight between the beginning of feeding and at the specified weight, multiplied by an average feed conversion ratio of 6:1 liveweight or approximately 12:1 carcase weight (Duddy et al., 2016; Linden, 2015). At the lower end of the spectrum, indicated by yellow shading, low store-lamb prices and low feed prices lead to lower cost of production, while the inverse is also true, highlighted in darker green. In this analysis, a sensitivity analysis of the feed costs has utilised a 25 per cent higher/lower comparison, rather than the 10 per cent sensitivity in the store-lamb costs. While this does skew the results somewhat to suggest that feed prices may have a stronger influence on cost of production than price of store lambs, it is indicative of the actual variability present in the feed grain market.

Table 7. Combined cost of purchasing store lambs and feed across scenarios ($)

	Low store lamb cost			Average store lamb cost			High store lamb cost		
Carcase weight (kg)	**Low feed**	**Ave feed**	**High feed**	**Low feed**	**Ave feed**	**High feed**	**Low feed**	**Ave feed**	**High feed**
20	106.51	110.11	113.71	117.22	120.82	124.42	127.93	131.53	135.13
23	117.31	124.51	131.71	128.02	135.22	142.42	138.73	145.93	153.13
26	128.11	138.91	149.71	138.82	149.62	160.42	149.53	160.33	171.13
29	138.91	153.31	167.71	149.62	164.02	178.42	160.33	174.73	189.13
32	149.71	167.71	185.71	160.42	178.42	196.42	171.13	189.13	207.13
35	160.51	182.11	203.71	171.22	192.82	214.42	181.93	203.53	225.13

Income sensitivity analysis

Using average prices with a 10 per cent adjustment for sensitivity analysis, the income generated from the sale of lotfed lambs at a range of weights can be found (Table 8).

Table 8. Income received from lambs at low, average and high price per kg cwt, using a “flat” grid (left) and “tight” grid (right)

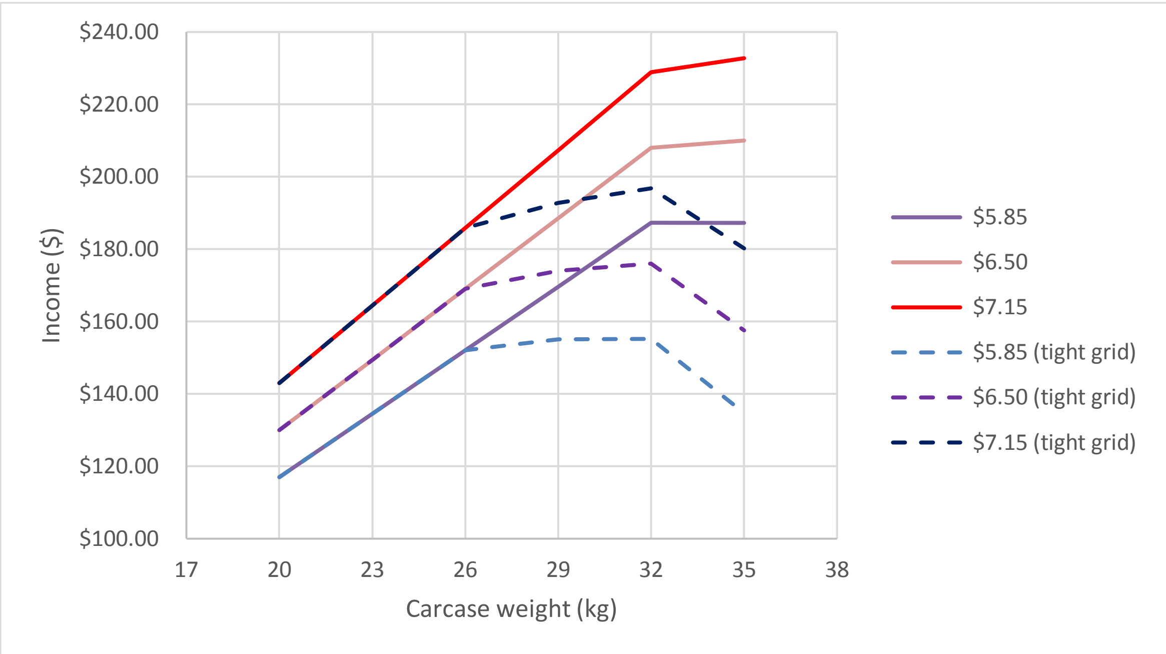
	Flat pricing grid		
Carcase weight (kg)	**$5.85**	**$6.50**	**$7.15**
20	$117.00	$130.00	$143.00
23	$134.55	$149.50	$164.45
26	$152.10	$169.00	$185.90
29	$169.65	$188.50	$207.35
32	$187.20	$208.00	$228.80
35	$187.25	$210.00	$232.75

	Tight pricing grid		
Carcase weight (kg)	**$5.85**	**$6.50**	**$7.15**
20	$ 117.00	$ 130.00	$ 143.00
23	$ 134.55	$ 149.50	$ 164.45
26	$ 152.10	$ 169.00	$ 185.90
29	$ 155.15	$ 174.00	$ 192.85
32	$ 155.20	$ 176.00	$ 196.80
35	$ 134.75	$ 157.50	$ 180.25

This pricing schedule on the left is based on the "flat" grid in Table 4, which consists of a flat price to 32 kg, with a 50c/kg discount from 32.1 kg onwards. A "tight" grid schedule on the right of Table 8 demonstrates the impact of severe discounts for supply lambs that are over the weight specification.

The influence of two grids on income is demonstrated in Figure 2, where solid lines indicate a "flat" grid and dashed lines indicate a "tight" grid. The lines are the same up to 26 kg carcase weight, as the two grids are identical to this point. From this point on, however, the dashed lines indicate the impact of the tighter grid on income, with decreasing income as weights increase and price penalties are incurred.

Figure 2. Income received for lambs at low, average and high price per kg cwt, using both flat (orange spectrum) and tight grids (blue spectrum)



Profit margin sensitivity analysis

When the cost and income are combined, using the low-average-high variable structure, the impact of the combination of factors can be demonstrated. Tables 9, 10 and 11 represent the variations present when store-lamb cost, feed cost, sale price and carcase weight are compared, to create a profit margin.

In instances where the sale price is low, the cost of feed and cost of store-lambs has a significant impact on profitability, particularly when combined. An example of this is that the average and high store-lamb cost scenarios, when combined with average or high feed cost variables, lead to below-break-even returns (less than $0 profit) and overall economic losses for the producer.

Where sale prices are average, in almost all test scenarios it is profitable to feed lambs to a heavier weight. It is only when store lamb cost is high and feed costs are also high that feeding lambs becomes unprofitable.

In contrast to the previous two scenarios, when lamb sale prices are above average, in all scenarios it is profitable to feed to a heavier weight.

Table 9. Profit margin where sale price is low, on a flat grid ($, blue indicating highest profit and red indicating least profit)

	Low store lamb cost			Average store lamb cost			High store lamb cost		
kg cwt	**Low feed**	**Ave feed**	**High feed**	**Low feed**	**Ave feed**	**High feed**	**Low feed**	**Ave feed**	**High feed**
20	10.49	6.89	3.29	-0.22	-3.82	-7.42	-10.93	-14.53	-18.13
23	17.24	10.04	2.84	6.53	-0.67	-7.87	-4.18	-11.38	-18.58
26	23.99	13.19	2.39	13.28	2.48	-8.32	2.57	-8.23	-19.03
29	30.74	16.34	1.94	20.03	5.63	-8.77	9.32	-5.08	-19.48
32	37.49	19.49	1.49	26.78	8.78	-9.22	16.07	-1.93	-19.93
35	26.74	5.14	-16.46	16.03	-5.57	-27.17	5.32	-16.28	-37.88

Table 10. Profit margin where sale price is average, on a flat grid ($, blue indicating highest profit and red indicating least profit)

	Low store lamb cost			Average store lamb cost			High store lamb cost		
kg cwt	**Low feed**	**Ave feed**	**High feed**	**Low feed**	**Ave feed**	**High feed**	**Low feed**	**Ave feed**	**High feed**
20	23.49	19.89	16.29	12.78	9.18	5.58	2.07	-1.53	-5.13
23	32.19	24.99	17.79	21.48	14.28	7.08	10.77	3.57	-3.63
26	40.89	30.09	19.29	30.18	19.38	8.58	19.47	8.67	-2.13
29	49.59	35.19	20.79	38.88	24.48	10.08	28.17	13.77	-0.63
32	58.29	40.29	22.29	47.58	29.58	11.58	36.87	18.87	0.87
35	49.49	27.89	6.29	38.78	17.18	-4.42	28.07	6.47	-15.13

Table 11. Profit margin where sale price is high, on a flat grid ($, blue indicating highest profit and red indicating least profit)

	Low store lamb cost			Average store lamb cost			High store lamb cost		
kg cwt	**Low feed**	**Ave feed**	**High feed**	**Low feed**	**Ave feed**	**High feed**	**Low feed**	**Ave feed**	**High feed**
20	36.49	32.89	29.29	25.78	22.18	18.58	15.07	11.47	7.87
23	47.14	39.94	32.74	36.43	29.23	22.03	25.72	18.52	11.32
26	57.79	46.99	36.19	47.08	36.28	25.48	36.37	25.57	14.77
29	68.44	54.04	39.64	57.73	43.33	28.93	47.02	32.62	18.22
32	79.09	61.09	43.09	68.38	50.38	32.38	57.67	39.67	21.67
35	72.24	50.64	29.04	61.53	39.93	18.33	50.82	29.22	7.62

Testing out a tighter grid

While the pricing grid structure demonstrated thus far is indicative of the current lamb pricing signals attached to specifications, the impact of tightening specifications and prices was also analysed. Using the grid in Table 5, a sensitivity analysis conducted in Tables 12, 13 and 14 demonstrates the impact that pricing pressure on heavier weight carcases can have. The greater discount associated with going over a preferred weight specification (in this example, 28.1 kg cwt as per Table 5) results in significant reduction in profit margins for over-heavy lambs.

While the general trends from a flat grid apply to this series of analyses, the pricing penalties of a tighter grid has a visible impact. In only two of the 27 tests conducted is it a profitable exercise to feed lambs to a carcase weight of 35 kilograms (these being low store cost/low feed cost and low store cost/average feed cost, both when sale prices are high). In low and average sale price scenarios feeding lambs to over 29 kilograms or above can have variable outcomes depending on store lamb and sale price, with low sale price scenarios demonstrating profitability in four of 18 scenarios and with average price scenarios demonstrating profitability in ten of 18 scenarios. However, in high sale price scenarios it is clear that a tighter grid does not have a significant impact on profitability until very high weights are reached, with nearly all scenarios (17 of 18) remaining profitable when carcase weights were either 29 or 32 kilograms.

Variable growth rates

It is not yet possible to select lambs on their FCR (Meat and Livestock Australia, 2007), which is the reason for selecting a base FCR of 6:1 in the modelling so far. However, it has been argued that growth rate and FCR can be a major determinant of profitability within a feedlot (Meat and Livestock Australia, 2007).

While lotfeeders may not be able to easily purchase lambs with demonstrated growth rates, many will have equipment to regularly weigh lambs and assess the growth rates of lambs on feed. Assuming that lambs eat around four per cent of their live weights on grain-based diets as kilograms of dry matter (kg DM), a 40 kg lamb will consume approximately 1.6 kg of feed and gain approximately 250 grams per day (Duddy et al., 2016). As grain and straw, basic components of a feedlot ration, are estimated to be approximately 90 per cent dry matter, this equates to 1.8 kg of feed as fed per lamb, per day (Agriculture Victoria, 2015).

Tables 15, 16 and 17 highlight the impact of growth rate on profitability, particularly at feeding to heavier weights. For example, with an average sale and feed price, feeding a slow-growing lamb to a 32 kg carcase weight will cost over $50 more than a fast-growing lamb, with the slower growing lamb making a loss overall.

Discussion

Costs and returns

Lambs sold at a heavier weight, purchased at low store-lamb prices and fed at low feed costs invariably were most profitable in “flat” grid scenarios, regardless of sale price and across growth rates. This supports the current industry trends of pricing signals attracting heavier weight lambs. However, sale price played an important role, with 25 of 56 “flat” grid scenarios where lamb income was low leading to a negative profit margin, and a further six scenarios were the profit margin was negligible (>$3 per head, Table 9).

Table 12. Profit margin where sale price is low, on a tight grid ($, blue indicating highest profit and red indicating least profit)

	Low store lamb cost			Average store lamb cost			High store lamb cost		
kg cwt	**Low feed**	**Ave feed**	**High feed**	**Low feed**	**Ave feed**	**High feed**	**Low feed**	**Ave feed**	**High feed**
20	10.49	6.89	3.29	-0.22	-3.82	-7.42	-10.93	-14.53	-18.13
23	17.24	10.04	2.84	6.53	-0.67	-7.87	-4.18	-11.38	-18.58
26	23.99	13.19	2.39	13.28	2.48	-8.32	2.57	-8.23	-19.03
29	16.24	1.84	-12.56	5.53	-8.87	-23.27	-5.18	-19.58	-33.98
32	5.49	-12.51	-30.51	-5.22	-23.22	-41.22	-15.93	-33.93	-51.93
35	-25.76	-47.36	-68.96	-36.47	-58.07	-79.67	-47.18	-68.78	-90.38

Table 13. Profit margin where sale price is average, on a tight grid

	Low store lamb cost			Average store lamb cost			High store lamb cost		
kg cwt	**Low feed**	**Ave feed**	**High feed**	**Low feed**	**Ave feed**	**High feed**	**Low feed**	**Ave feed**	**High feed**
20	23.49	19.89	16.29	12.78	9.18	5.58	2.07	-1.53	-5.13
23	32.19	24.99	17.79	21.48	14.28	7.08	10.77	3.57	-3.63
26	40.89	30.09	19.29	30.18	19.38	8.58	19.47	8.67	-2.13
29	35.09	20.69	6.29	24.38	9.98	-4.42	13.67	-0.73	-15.13
32	26.29	8.29	-9.71	15.58	-2.42	-20.42	4.87	-13.13	-31.13
35	-3.01	-24.61	-46.21	-13.72	-35.32	-56.92	-24.43	-46.03	-67.63

Table 14. Profit margin where sale price is high, on a tight grid

	Low store lamb cost			Average store lamb cost			High store lamb cost		
kg cwt	**Low feed**	**Ave feed**	**High feed**	**Low feed**	**Ave feed**	**High feed**	**Low feed**	**Ave feed**	**High feed**
20	36.49	32.89	29.29	25.78	22.18	18.58	15.07	11.47	7.87
23	47.14	39.94	32.74	36.43	29.23	22.03	25.72	18.52	11.32
26	57.79	46.99	36.19	47.08	36.28	25.48	36.37	25.57	14.77
29	53.94	39.54	25.14	43.23	28.83	14.43	32.52	18.12	3.72
32	47.09	29.09	11.09	36.38	18.38	0.38	25.67	7.67	-10.33
35	19.74	-1.86	-23.46	9.03	-12.57	-34.17	-1.68	-23.28	-44.88

Table 15. Profit margin where sale price is low and store cost is average, with variable feed price and growth rates, on a flat grid

	Low feed price			Average feed price			High feed price		
kg cwt	**200g**	**300g**	**400g**	**200g**	**300g**	**400g**	**200g**	**300g**	**400g**
20	-3.50	1.00	3.25	-8	-2	1	-12.5	-5	-1.25
23	-2.15	7.75	12.70	-12.05	1.15	7.75	-21.95	-5.45	2.8
26	-0.80	14.50	22.15	-16.1	4.3	14.5	-31.4	-5.9	6.85
29	0.55	21.25	31.60	-20.15	7.45	21.25	-40.85	-6.35	10.9
32	1.90	28.00	41.05	-24.2	10.6	28	-50.3	-6.8	14.95
35	-14.25	17.25	33.00	-45.75	-3.75	17.25	-77.25	-24.75	1.5

Table 16. Profit margin where sale price and store cost are average, with variable feed price and growth rates, on a flat grid

	Low feed price			Average feed price			High feed price		
kg cwt	**200g**	**300g**	**400g**	**200g**	**300g**	**400g**	**200g**	**300g**	**400g**
20	9.5	14	16.25	5	11	14	0.5	8	11.75
23	12.8	22.7	27.65	2.9	16.1	22.7	-7	9.5	17.75
26	16.1	31.4	39.05	0.8	21.2	31.4	-14.5	11	23.75
29	19.4	40.1	50.45	-1.3	26.3	40.1	-22	12.5	29.75
32	22.7	48.8	61.85	-3.4	31.4	48.8	-29.5	14	35.75
35	8.5	40	55.75	-23	19	40	-54.5	-2	24.25

Table 17. Profit margin where sale price is high and store cost is average, with variable feed price and growth rates, on a flat grid

	Low feed price			Average feed price			High feed price		
kg cwt	**200g**	**300g**	**400g**	**200g**	**300g**	**400g**	**200g**	**300g**	**400g**
20	22.5	27	29.25	18	24	27	13.5	21	24.75
23	27.75	37.65	42.6	17.85	31.05	37.65	7.95	24.45	32.7
26	33	48.3	55.95	17.7	38.1	48.3	2.4	27.9	40.65
29	38.25	58.95	69.3	17.55	45.15	58.95	-3.15	31.35	48.6
32	43.5	69.6	82.65	17.4	52.2	69.6	-8.7	34.8	56.55
35	31.25	62.75	78.5	-0.25	41.75	62.75	-31.75	20.75	47

In contrast, when lambs are sold at a high price, even the most expensive lamb purchase and feed costs were outweighed by the income, meaning that all scenarios in that dataset were profitable (Table 11). Using the analysis in Table 10, a producer who would normally consign lambs for slaughter at 23 kg may decide to feed their average purchase price, average feed cost lambs to a heavier weight specification, for example to 29 kg, with the expectation of $15.30 in additional profit margin per lamb. In comparison, during periods of poor seasonal conditions, such as drought, an oversupply of lambs can lead to falling lamb prices while feed costs remain high, such as the low-price, low store cost, high feed price scenario in Table 9. In this instance, feeding lambs is not a profitable decision. Store-lamb price was an important factor to consider, although the main impact of this factor was delaying the break-even point, meaning that lambs would have to be on feed for a longer period, reaching a heavier weight, before making a relative profit.

Supporting the view that the grid price, with discounts matched to specifications, encourages heavier lambs, the "tight" grid analyses in Tables 12, 13 and 14 demonstrate that the most profitable option is to feed to the heaviest weight within the specification. Once weights fell into the over-heavy specification, the discount applied severely impacted the profitability of feeding the lambs. Even the minor discount in the "flat" grid had an impact on profitability of lambs at 35 kg carcase weight, as their feed costs increased with weight while their income stagnated. This is an important reminder that while specifications may be broad at present, it is worthwhile ensuring that lambs do fit within the pricing grid specifications to attain the maximum profit margin.

In answer to the question "is the current market signal for heavy lambs economically sensible for a lotfeeder to target?", the sensitivity analyses suggest that it is economically sensible when:

- Lamb sale prices are high, in all cost scenarios, to within the heaviest, non-discounted weight specification, in both "flat" and "tight" grids,
- Lambs are fed to over 23 kg, at least one of the cost variables is low (low feed or low feeder lamb cost) and within the heaviest weight specification in both "flat" and "tight" grids, and
- When sale price is average, and the feed/store lamb costs are not both high, in both "flat" and "tight" grids.

Growth rate

Growth rates had a substantial impact on the cost associated with feeding lambs. Only at low feed prices was feeding slower-growing lambs a profitable option: in all cases where growth rates were 200 grams/day and feed costs were average or higher, the profit margin decreased as the lambs' carcase weights increased. The impact of growth rate on profitability is particularly important to consider when lamb growth rates change or slow down, for example as they mature.

While selecting lambs for FCR is not yet a feasible practice, decision making based on growth rate may be of benefit to a lotfeeding producer. Lambs with high growth rates will have the best chance of having suitable FCR"s. Removing slow-growing lambs will not only influence the cost of feeding, it will also keep the mob as a cohort of similar growth patterns, which may help to minimise the incidence of shy feeders. A cohort of similarly-growing, consistent lambs may also make management and selling easier. With the increasing adoption of individual animal traceability and recording in Victoria, marketing options for store lambs in the future may also include their recent growth rates, meaning that specialist finishers may be better able to predict the lambs' suitability for lotfeeding prior to purchase.

These results provide a valuable guide as to the influence of certain variables on the decision to feed lambs to a heavier weight specification than otherwise planned. However, they are essentially a "back of the envelope" calculation, and do not take into account other factors that will impact the profitability of such an enterprise. Some of these factors are explored further below.

Areas for further research

A key issue with estimating feed costs linked to growth rate is that lambs may have differing maintenance requirements in addition to growth requirements, and that the energetic intake will differ based on the body composition and maturity of the animals (Linden, 2015). This makes assessing the cost of production linked to the growth rate and feed efficiency of individual lambs extremely difficult. As a result, the industry tends to use an average FCR, despite the knowledge that this can vary enormously between lambs. Further research and development into methods and standards for assessing feed efficiency in lambs, such as identifying clear trigger points for feeding lambs, and commercialisation of products or techniques to be adopted by the industry, will be critical in optimising the efficiency of Australian lamb production.

In addition to the broader question about maintenance versus growth efficiency is the question of fat, and the role of fat maintenance and deposition in the overall feed intake. As Linden (2015) noted, there is a strong awareness that overall efficiency declines as animals become fatter; however, the extent to which this impacts on the efficiency of animals within a feedlot environment and overall systems efficiency is largely unstudied.

Furthermore, the maturity pattern of the lamb will influence the deposition of fat, with proportionately more fat than muscle deposited with growth at later maturity stages (Graham & Searle, 1972). This may be linked to the decline in growth rate and feed efficiency for older lambs, making them more expensive to produce (Linden, 2015). Considering that most fattening occurs after lambs reach 30 kg liveweight, it follows that heavier lambs will also be fatter (Graham & Searle, 1972). This has implications for feeding lambs to heavier weights, not only in terms of potentially higher feed costs associated with adding body weight when feed efficiency is decreasing, but also in increasing the proportion of fat in the carcase, which is considered to be of lower value, and in some ways a waste product, by the processing industry. At the moment, this cost is not reflected in grid structures, but a waste product such as excess fat may be targeted by tightening market specifications in the future.

Finally, the introduction of new technologies and systems such as dual-energy x-ray absorptiometry (DEXA) which allows fast and accurate analysis of lean meat yield, and cuts-based eating quality standards such as a revised Meat Standards Australia for sheep meat, may have a significant impact on the lamb industry. While, anecdotally, there is much speculation about what the impact of these new technologies may be on market specifications, their potential influence on pricing signals will not be apparent until the technologies have been adopted. These are efficiency-enhancing developments that may transform the lamb supply chain in Australia.

Conclusion

Current market specifications with "flat" grids are encouraging the supply of heavier lambs in the Australian sheep industry. However, there are a range of factors that may influence a lotfeeder's profitability when targeting a heavier weight. This project was designed to establish whether it was an economically sensible strategy for lamb feedlot operators to target a heavy weight specification, given the current lamb market's pricing signal favouring production of heavy lambs.

Through a literature review, simple modelling and a range of sensitivity analyses, this study identified that with the current market signals, it is an economically sensible decision to target a heavy weight specification, considering several specific conditions. While feed costs, store-lamb prices, growth rates and sale prices all influence the profit margin of feeding lambs to a heavier weight, when sale prices were at least ten per cent higher than the average it was a profitable thing to do. When sale prices are average or low, if at least one other cost variable is low, it is similarly a sensible decision. In addition to these cost/income parameters, this report supports the industry belief that lambs must be growing at a minimum of 300 grams per day to be profitable in a feedlot, unless feed prices are particularly low. In all cases, although emphasised in "tight" grid scenarios, lambs should be within the weight specification to achieve maximum profit margins.

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Sample of data - Test 3 - Profit margin sensitivity analysis, flat grid

Reference data

	Low	Average	High
Feed conversion ratio (FCR carcase weight)	6	12	18
Feed conversion ratio (FCR liveweight)	3	6	9
Store price ($ per head)	95.71	106.42	117.13
Feed price ($/kg)	0.3	0.4	0.5
Sale price ($/kg cwt)	5.85	6.5	7.15
Start weight (kg cwt)		17	

Formulae

Income	End weight x sale price*
Cost	((end weight - start weight) x FCR carcaseweight x feed price) + store lamb cost
Profit margin	Income - cost

* Sale price is impacted by grid discounts, eg on a flat grid the 35 kg carcase will be affected by a 50c penalty, so formula would read: **end weight x (sale price - 0.50)**

Income ($)

Flat grid

	Sale price		
kg cwt	**5.85**	**6.5**	**7.15**
20	117	130	143
23	134.55	149.5	164.45
26	152.1	169	185.9
29	169.65	188.5	207.35
32	187.2	208	228.8
35	187.25	210	232.75

Cost of production ($)

	Low store lamb cost			Average store lamb cost			High store lamb cost		
kg cwt	**Low feed**	**Ave feed**	**High feed**	**Low feed**	**Ave feed**	**High feed**	**Low feed**	**Ave feed**	**High feed**
20	106.51	110.11	113.71	117.22	120.82	124.42	127.93	131.53	135.13
23	117.31	124.51	131.71	128.02	135.22	142.42	138.73	145.93	153.13
26	128.11	138.91	149.71	138.82	149.62	160.42	149.53	160.33	171.13
29	138.91	153.31	167.71	149.62	164.02	178.42	160.33	174.73	189.13
32	149.71	167.71	185.71	160.42	178.42	196.42	171.13	189.13	207.13
35	160.51	182.11	203.71	171.22	192.82	214.42	181.93	203.53	225.13

Profit margin ($)

		Low store lamb cost			Average store lamb cost			High store lamb cost		
	kg cwt	**Low feed**	**Ave feed**	**High feed**	**Low feed**	**Ave feed**	**High feed**	**Low feed**	**Ave feed**	**High feed**
Low sale price scenario	**20**	10.49	6.89	3.29	-0.22	-3.82	-7.42	-10.93	-14.53	-18.13
	23	17.24	10.04	2.84	6.53	-0.67	-7.87	-4.18	-11.38	-18.58
	26	23.99	13.19	2.39	13.28	2.48	-8.32	2.57	-8.23	-19.03
	29	30.74	16.34	1.94	20.03	5.63	-8.77	9.32	-5.08	-19.48
	32	37.49	19.49	1.49	26.78	8.78	-9.22	16.07	-1.93	-19.93
	35	26.74	5.14	-16.46	16.03	-5.57	-27.17	5.32	-16.28	-37.88

		Low store lamb cost			Average store lamb cost			High store lamb cost		
	kg cwt	**Low feed**	**Ave feed**	**High feed**	**Low feed**	**Ave feed**	**High feed**	**Low feed**	**Ave feed**	**High feed**
Average price scenario	**20**	23.49	19.89	16.29	12.78	9.18	5.58	2.07	-1.53	-5.13
	23	32.19	24.99	17.79	21.48	14.28	7.08	10.77	3.57	-3.63
	26	40.89	30.09	19.29	30.18	19.38	8.58	19.47	8.67	-2.13
	29	49.59	35.19	20.79	38.88	24.48	10.08	28.17	13.77	-0.63
	32	58.29	40.29	22.29	47.58	29.58	11.58	36.87	18.87	0.87
	35	49.49	27.89	6.29	38.78	17.18	-4.42	28.07	6.47	-15.13

		Low store lamb cost			Average store lamb cost			High store lamb cost		
	kg cwt	**Low feed**	**Ave feed**	**High feed**	**Low feed**	**Ave feed**	**High feed**	**Low feed**	**Ave feed**	**High feed**
High price scenario	**20**	36.49	32.89	29.29	25.78	22.18	18.58	15.07	11.47	7.87
	23	47.14	39.94	32.74	36.43	29.23	22.03	25.72	18.52	11.32
	26	57.79	46.99	36.19	47.08	36.28	25.48	36.37	25.57	14.77
	29	68.44	54.04	39.64	57.73	43.33	28.93	47.02	32.62	18.22
	32	79.09	61.09	43.09	68.38	50.38	32.38	57.67	39.67	21.67
	35	72.24	50.64	29.04	61.53	39.93	18.33	50.82	29.22	7.62