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What farmer types are most likely to adopt joint venture farm business structures?*

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Joint venture (JV) farm structures have the potential to increase the productivity and profitability of traditional family farms. However, such structures are not widely adopted within the farm business community. Furthermore, knowledge on the relative attractiveness of different JV models to farmers is limited. We use a choice experiment to explore what JV structures are preferred by Australian farmers, and how farmers' socio-demographic and attitudinal characteristics influence the type of JV structure preferred. A latent class analysis revealed significant unobserved preference heterogeneity amongst the population. We identify four latent classes that differ in their preferences regarding the number of JV partners, access to new machinery, and/or the opportunity for additional annual leave. All classes of farmers displayed positive preferences for operational decision-making with other JV partners, although they varied in their preferences towards final operational responsibility. The diversity in preferences shows that there is no 'one size fits all' JV design, leaving opportunities for a range of JV decision models. Such flexibility in JV design is likely to have advantages when seeking JV partners, with a significant proportion of the sampled population open to collaborative decision-making models.

Key words: choice modelling, farm management, innovation adoption, latent class analysis, organisational innovation.

1. Introduction

Independent family-owned farming operations are still the predominant business structure in many agricultural sectors throughout the world

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(Magnan 2012; Graeub *et al.* 2016; Contzen and Forney 2017). However, the average family farm business faces increasing productivity challenges that need to be overcome (ABARES 2010). Farmers will need to innovate to enable expansion and remain competitive in a global market (Soriano *et al.,* 2018). It has been found that larger farms are more productive and possibly also more efficient than smaller farmers, because of economies of size and greater financial capacity to invest in innovations (Sheng *et al.* 2014; Sheng and Chancellor 2018). Collaborative farming offers opportunities for groups of farmers to share resources to achieve economies of scope and scale that cannot be achieved by a single family farm (Magnan 2012; Curran 2014). Organisational business innovations, like collaborative joint venture (JV) farm structures (Krause 1973; Kingwell *et al.* 2018), have the potential to increase the productivity and profitability of family farms (ADAS 2007; Gladigau 2013). Business alliance structures like JVs are commonly used in the broader economy to increase firm competiveness by gaining strategic and operational advantages that would be difficult to obtain as a stand-alone entity (Sheth and Parvatiyar 1992). However, such structures are not widely adopted within the farm business community. We currently do not know the relative attractiveness of different JV models, and how farmer characteristics affect their preferences for different JV structures.

This study will address this knowledge gap by using a choice experiment to explore what JV structures are most attractive to Australian grain farmers. We undertake a latent class analysis to explore unobserved heterogeneity of farmer preferences for JV structures. Our aim is to improve understanding of the potential for JV farm business structures, which will assist stakeholders interested in innovating their farm business structures to identify partnerships with the greatest potential for success. Our paper differs significantly from Kingwell *et al.* (2018), who developed a financial model for Western Australia. The authors concluded that farm and farmer characteristics are likely to influence the likelihood of finding a suitable JV partner. Our analysis is based on an Australia-wide survey. We explain farmers' interest in the different characteristics of a JV structure through (amongst others) farmer-level characteristics and motivations.

There exist different farm business structures that allow owner-operated farms to expand and increase their productivity, access to capital, and business opportunities. Share-farming, share-milking, contract farming, machinery syndicates, or leasing land from another entity are relatively common partnerships (Ingram and Kirwan 2011; NRAC 2013). More recent developments have seen Australian agricultural businesses establish equity partnerships, where a family farm partners with an investor from outside the agricultural sector such as superannuation or other private equity funds (Alexander 2015). Vertically integrated company structures, where a farmer and a retailer or processor establish an offtake agreement, allow supply chain integration and reduce costs (ANZ 2016). The focus of the current paper is on collaborative farming ventures where the assets, infrastructure, and skills of two or more farming businesses are

combined (Lynch *et al*. 2018). We use a choice experiment to investigate what characteristics of the JV structure are more or less attractive to farmers.

The choice experiment method and modelling approaches are detailed in the next section, followed by a description of the questionnaire in Section 2.2. Results of the questionnaire and latent class models are presented in Section 3. The paper concludes with a discussion of the challenges and implications for policymakers and other stakeholders interested in the future adoption and diffusion of organisational innovations, like JV structures, by farmers in the Australian grain sector.

2. The choice experiment method

Joint venture business models are neither widely adopted nor traded in markets to allow the use of revealed preference techniques or rely on market transactions. A stated preference survey like a discrete choice experiment[1] (CE) is well suited for this study because it allows us to study farmer preferences for hypothetical circumstances like potential JV structures. The CE method has been applied in a range of agricultural contexts such as farmers' willingness to adopt environmentally friendly practices (Jaeck and Lifran 2014), crop diversification decisions (Windle and Rolfe 2005), or pastoralists' willingness to engage in biodiversity conservation (Greiner 2016), but it is rarely used in an agribusiness domain (Kragt and Llewellyn 2014).

The theoretical foundation of CEs comes from random utility theory (McFadden 1986) and Lancaster's theory of value (Lancaster 1966). Random utility theory is based on a model where utility U_{ijt} an individual i obtains from choice j in situation t is described as a latent variable which is observed indirectly via the individual's choices. Utility is comprised of an observed, 'systematic', utility element V_{ijt} and a random, unobserved, error term ε_{ijt} that is typically assumed to be independently and identically distributed (Louviere *et al*. 2000). The foundation of Lancaster's theory of value is that a good can be described in terms of its multiple characteristics (called 'attributes'), which impact utility as components of X_{ijt}:

$$U_{ijt} = V_{ijt} + \varepsilon_{ijt} = X_{ijt}\beta_i + \varepsilon_{ijt} \quad i = 1, 2, \ldots, N; j = 1, 2, \ldots, J; t = 1, 2, \ldots, T \tag{1}$$

The observed element of utility V_{ijt} is assumed to be a function of a vector of explanatory variables X_{ijt} that includes attributes of the good under valuation, and may further include socio-demographic characteristics and features of the choice task itself (Hensher and Greene 2003). The CE allows us to infer people's values for the different attributes of a good relative to the other attributes included in the survey. In this study, respondents were shown multiple alternatives for JV structures, which vary in the level of their

[1] CEs are a form of conjoint analysis, sometimes also called 'choice modelling'.

attributes (Section 3). Respondents' choices between alternatives allow the researcher to infer the trade-offs respondents implicitly make between attributes and levels (Bennett and Blamey 2001).

2.1. Latent class modelling

Adopting a JV farm business structure is inherently complex and entails the consideration of both market and non-market costs and benefits. The adoption decision is also characterised by considerable reversibility costs, which obviously have significant implications for the risk profile of the farm businesses involved (Gray *et al.* 2009; Gladigau 2013; Kingwell *et al.* 2018). Given the inherent characteristics of the innovation, it is likely that farmer preferences for JV structures are heterogeneous, depending on, for example, an individual's circumstances and their attitude to risk and collaboration. To explore this potential preference heterogeneity, we estimate latent class (LC) models, which have been widely used in the literature, in a variety of agricultural economics contexts (Kerr and Sharp 2008; Colombo *et al.* 2009; Ruto and Garrod 2009).

While observable characteristics such as socio-demographic variables can be included in the utility function to explain heterogeneity, CE research increasingly shows the need to account for *unobserved* heterogeneity in CE modelling (Hensher *et al.* 2005). LC models can capture unobserved heterogeneity by assuming a discrete distribute of preference parameters where different preference 'classes' exist within a population. Preferences are assumed to be homogeneous within each class. The LC model structure is appropriate for this study because it allows us to explore the preferences of different 'market segments' within the sample population and thus identify broad farmer types with similar preferences.

The LC model assumes that a population consists of discrete number of classes, in which preferences β_c are homogenous within Class c but may vary between classes (Heckman and Singer 1984). In a LC model, the probability that an individual i chooses alternative j in choice situation t follows the typical logit formula but is conditional on that individual belonging to Class c follows a convenient multinomial logit (MNL) form (Greene and Hensher 2003):

$$Prob_{it|class\ c}(j) = P_{it,j|c} = \frac{exp(X_{it,j}\beta_c)}{\sum_{j=1}^{J} exp(X_{it,j}\beta_c)} \tag{2}$$

One of the strengths of the LC model is that the analyst can control for the panel nature of CE data by allowing for any potential systematic, but unobserved, correlations in the repeated choices made by individual i (Revelt and Train 1998). What is modelled is not the within choice task choice probability as in Equation (2), but the joint probability of observing the particular sequence of choices made by individual i:

$$P_{it,j} = \sum_{c \in C} P_{ic} \prod_{t} P_{it,j|c} \tag{3}$$

Of interest are the estimated class proportions (P_{ic}) and the class-specific response probabilities ($P_{it,j|c}$). These parameters are found through maximum likelihood estimation.

Initially, attribute-only LC models with varying numbers of classes were evaluated. Model selection was guided by the Bayesian information criterion (BIC), R^2, class sizes, and the number of preference parameters in the model.

In this paper, we are further interested in potential socio-demographic and attitudinal differences between classes. This is done by including observable characteristics (covariates) in the class membership function P_{ic}, which is estimated as a MNL model (Hensher *et al.* 2015). This approach has successfully been used to predict class membership in the LC models of: Scarpa *et al.* (2007); Hynes *et al.* (2008); Kerr and Sharp (2008); and Burton *et al.* (2017).

2.2. Questionnaire development

The CE questionnaire was developed and designed following best-practice guidelines (Louviere *et al.* 2000; Bennett and Adamowicz 2001; Hensher *et al.* 2005). In addition to non-market valuation experts, a team of farm business experts was consulted during the questionnaire development phase, encompassing farm extension, farm management consultants, and farmers, including farm JV practitioners. Pre-testing of the questionnaire was undertaken through one-on-one interviews with farmers and workshops with groups of farmers, before an online pilot questionnaire was launched and tested. Minor changes were made to the questionnaire design before the final questionnaire was launched in July 2013.

The JV scenarios in the CE included five attributes that varied in levels between choice sets. These attributes were: (i) the number of farm businesses in the JV structure; (ii) influence on operational decisions; (iii) farming with the latest machinery; (iv) leave arrangements; and (v) change in annual net farm income (Table 1). Attribute levels were based on feedback from experts and farmers involved in pre-testing. The change in net farm income attribute was further based on the analysis of farm financial performance data at the national scale (ABARES 2010), and financial performance benchmarks at the agro-ecological zone scale across the southern and western grain-growing regions of Australia (Hooper and Levantis 2011).

The questionnaire started with general questions about JV farm structures and other forms of farmer collaboration, which aimed to gauge respondents' familiarity with JVs and general interest in collaboration. We then explained the attributes and choice task, followed by the choice questions. The final section contained a range of socio-demographic and attitudinal questions.

Table 1 Attributes and levels used in the farmer joint venture choice experiment

Attribute	Attribute description	Attribute levels
Number of farm businesses in the JV structure	A JV will be comprised of a number of individual farm businesses that will be equal shareholders in the new JV business structure.	2, 3, or 4 farm businesses
Influence on operational decisions	Despite equal shareholdings and representation on the board, individual farm families may have varying levels of direct influence/control over farm operational decisions for the whole JV.	Sole decision-maker (coded 1); Final decision-maker, in consultation with other partners (2); Shared decision-making with other partners (3); Not the final decision-maker, but input into decisions (4); and No operational decisions (5)
Farming with the latest machinery	The JV farm structure may increase the feasibility that JV partners can procure the latest machinery.	New machinery, Older machinery (initially 5 yrs plus)
Leave arrangements	The extra workforce in a JV may allow farm families to take more leave (holidays) away from the farm.	Extra 2 weeks leave, no change
Change in annual net farm income	Adopting a JV structure will likely result in a change to a farm family's average annual net farm income. This change in income will be relative to a family's average net farm income over the past 5 years.	−15k, no change, 15k, 30k, 50k, and 75k

The choice sets were constructed using a Bayesian D-efficient design (Sándor and Wedel 2001), with a total of 20 choice sets divided into four blocks. These blocks were evenly distributed at the regional and national scale. Each respondent was allocated to a block and completed five choice sets. Respondents were asked to identify their most preferred structure from four alternatives (Figure 1). An opt-out option was not provided in the choice sets because we are interested in the relative importance of different JV attributes, as opposed to eliciting absolute values for attributes, and also to avoid potential non-choices because of the potentially likely low levels of awareness of JV farm structures amongst the target audience.

Before commencing the choice tasks, respondents were explained what JVs are and their basic operating principles. A JV structure was defined as "a business structure that combines the assets, infrastructure, and staff of two or more farm businesses". The JV operating conditions were based on a combination of expert opinion and from the experience of practitioners' currently involved in similar JV structures (Gladigau 2013). The way in which

Carefully consider each of the following options for formal JV structures.
If Options A, B, C, and D were the only ones available, which option would be most attractive to you?

Characteristics	Option A	Option B	Option C	Option D
Number of farm businesses in the JV structure	2	3	4	4
Your influence on operational decisions (non-board decisions)	Sole decision-maker	Shared decision-maker with other partners	Not the final decision-maker, but input into decisions	No operational decisions
Farming with the latest machinery	Older machinery (initially 5yrs plus)	New machinery	New machinery	New machinery
Leave arrangements	Extra 2 weeks of flexible leave	No change	No change	Extra 2 weeks of flexible leave
Change in annual net farm income (compared to your current 5yr average)	+ $30 k	No change	+ $50 k	+ $15 k
Most attractive option	☐	☐	☐	☐

Figure 1 Example choice set used in the farmer joint venture choice experiment questionnaire

the JV operating conditions were described in the survey is available in the Appendix.

The CE questionnaire was administered online with broadacre grain producers between July and September 2013. A market research firm randomly recruited a sample of farm managers until the target number of respondents for each region was reached, ensuring a balanced regional sample across the major growing regions of New South Wales, Victoria, South Australia, and Western Australia. Farm managers were contacted by telephone, and those who agreed to participate were sent a secure web link via email to access the questionnaire. A follow-up phone call was made shortly after each email was sent to confirm the respondent had received the web link.

3. Results

Out of the 4,137 farm businesses contacted, 47.9 per cent did not qualify due to land size, farm type, lack of internet connection, or because the primary cropping decision-maker was not available. Of the 2,155 eligible farmers, 340 completed questionnaires were collected: a response rate of 15.7 per cent. The vast majority of respondents were male (96 per cent – Table 2) with an average age of 52 years. Average farm size was approximately 2,625 hectares with cropped area ranging from 324 to 18,500 hectares. About half of the respondents had expanded their crop area in the past five years, and about 40 per cent of respondents were aware of grain farmers that had entered a JV. The majority of respondents were willing to take higher financial risk in their farm business to realise higher average returns, and agreed that the flexibility to opt for a reduced workload makes a JV structure attractive.

Table 2 Variable descriptions and descriptive statistics for the sample (n = 340)

Variable	Description	Mean	SD (range)	
Gender	1 = Male; 0 = Female	0.96	0.21	
Age	Farmer age (yrs)	52	10.2 (21–70)	
University degree	1 = Has a university degree; 0 = No university degree	0.12	0.33	
Farm area	Area of land owned + leased + share-farmed (ha)	2,625	1,986 (453–18,500)	
Area of grain	Current grain crop area (ha)	1,626	1,461 (324–18,500)	
Annual leave	Current annual leave: −1 = 2 weeks or less; 0 = 3 - 4 weeks leave; 1 = > 4 weeks	−0.31	0.65	
Farm expansion	1 = Has expanded crop area in the last 5 yrs via purchase or lease; 0 = No expansion	0.51	0.5	
JV Awareness	1 = Familiar or aware of grain farmers that have entered a JV; 0 = No	0.40	0.49	
		−1 = No	0 = Maybe	1 = yes/already in one
JV interest	I would consider forming a JV (no. of respondents)	139	148	53
		−1 = disagree	0 = neither agree nor disagree	1 = agree
Risk Tolerance	I am willing to take on higher financial risks in my farm business in order to realise higher average returns (no. of respondents)	94	101	145
JV risky	I think the downside risks of a formal joint venture structure outweigh the possible benefits for my farm business (no. of respondents)	68	130	142
JV flexible	Having the flexibility to opt for a reduced workload makes a joint venture structure attractive (no. of respondents)	74	89	177

To explore farmer preferences for JV structure attributes, we estimated LC models in Nlogit v.5 (Econometric Software 2012). Based on the BIC values, the four and five class specifications provided the best fit to our data. Models with more than five classes produced improbable estimates for some of the attributes (in particular for partners = 3). A range of farmer characteristics

Table 3 Latent class model result for the preferred four-class model (n = 340)

Class Latent class probabilities	Class A 35.8%	Class B 35.5%	Class C 16.8%	Class D 11.9%
Parameters in preference function				
Income	**0.028***** (0.003)	**0.059***** (0.006)	**0.019**** (0.008)	**0.021***** (0.007)
2 JV partners	0.239 (0.162)	**0.689***** (0.171)	**0.788*** (0.405)	−0.400 (0.366)
3 JV partners	−0.114 (0.237)	−0.621 (0.468)	−0.004 (0.376)	−0.694 (0.436)
4 JV partners (Base Case)	–	–	–	–
No operational decisions (Base Case)	–	–	–	–
Not the final decision-maker, but input into decisions	**1.056**** (0.462)	**2.015***** (0.466)	**1.535***** (0.569)	0.631 (1.221)
Shared decision-making with other partners	**2.591***** (0.397)	**2.277***** (0.456)	**2.045***** (0.608)	**4.134***** (0.998)
Final decision-maker, in consultation with other partners	**2.981***** (0.391)	**1.735***** (0.447)	0.472 (0.659)	**3.572***** (0.878)
Sole decision-maker	**3.592***** (0.352)	**0.751***** (0.242)	**−1.097*** (0.660)	1.116 (0.746)
New machinery	−0.034 (0.139)	**0.383**** (0.183)	−0.528 (0.339)	**1.670***** (0.412)
Extra leave	−0.294 (0.277)	**1.056***** (0.309)	**−0.999**** (0.485)	0.395 (0.487)
Parameters in class membership function				
Constant	**0.537***(0.318)	−0.010 (0.431)		**−0.816*** (0.441)
Risk tolerance (−1/0/1)	**0.499*** (0.300)	0.308 (0.285)		0.537 (0.351)
Farm expansion (0/1)	**1.049***(0.585)	**1.385***** (0.525)		0.835 (0.634)
JV flexible (−1/0/1)	**−1.412***** (0.354)	0.229 (0.343)		0.151 (0.437)
Log-likelihood	−1,556			
BIC	3,468			

Note: Significant values in bold. *$P < 0.1$; **$P < 0.05$; ***$P < 0.01$. Standard errors in parentheses.

was then systematically included as covariates in P_{ic} and the models re-run to obtain the final model. The best-fit model contained four preference classes and included risk tolerance, farm expansion, and flexibility of work as explanatory variables in the class membership function (Table 3). No other characteristics were significant in explaining class membership.

The four-class model contains two larger classes (A and B; both about 35.5 per cent) and two smaller classes (Class C: 17 per cent, Class D: 12 per cent). As expected, income is significant and positive for all classes. This is not surprising as it means that farmers prefer JV structures that offer opportunities to get higher income. There is heterogeneity in preferences for the number of JV partners. Classes B and C displayed a significant positive preference for JV structures involving two partners instead of the base case of four partners, while Classes A and D were indifferent towards the number of partners involved in a JV structure (within the choice context presented).

Regarding influence on operational decisions, all classes, except Class C, had a significant positive utility for 'shared decision-making with other partners' and 'final control over operational decision-making in consultation with other partners'. Class A in particular, and Class B to a smaller extent, displayed a significant positive utility for JV structures in which they were the 'sole decision-maker', making people in these classes a less likely partner in a JV structure with other farmers.

Farmers in Classes B and D were attracted by the possibility of new machinery, and farmers in Class B also displayed a significant positive utility for 2-week additional annual leave. Classes A and D did not value more leave beyond their current leave arrangements.

The covariates in the class membership function were evaluated against Class C (base). Farmers were more likely to be in Class A if they were willing to take higher financial risk ('risk tolerance') and were likely to disagree that "having the flexibility to opt for a reduced workload makes a JV structure attractive" ('JV flexible'). Both respondents in Class A and Class B were likely to include farmers who had expanded their crop area in the past five years ('farm expansion'). This suggests that farmers who have been able to expand their operations may not have a need for novel business structures (these classes also displayed a preference towards sole or final decision-making).

4. Discussion

In this study, we aim to understand how heterogeneity between farmers affects their preferences for characteristics of JV structures. A four-class LC model shows that there is significant unobserved heterogeneity in preferences amongst the sample population. All classes demonstrated significant preferences for options that offered some input or control over operational decisions with JV partners, compared to the base case of no control over operational decisions. However, the strength in preferences varies. Respondents in Class A appear to strongly prefer business structures in which they

have most or complete control in the operational decision-making process relative to the other classes. Conversely, farmers in Class C are not seeking final decision-making authority.

The fact that the majority of respondents indicated a willingness to forgo at least some degree of operational control is an important finding. This result demonstrates there is potential for a range of JV structures to be developed, with different levels of operational control that align with a broad pool of potential JV partners. The majority of respondents (Classes A, B, and D) prefer to either maintain sole decision-making or consultative decision-making. This means that sharing operational decisions with another farmer as a JV partner may not be the most attractive option to these respondents. Respondents in these classes may be more interested in passive investors, such as public pension funds or high net worth individuals (ANZ 2016), as JV partners to raise the necessary capital to expand operations.

Interestingly, Classes A and D were indifferent to the number of JV partners (2, 3, or 4 partners). However, the other two classes (52.3 per cent) significantly preferred JV structure containing two partners instead of four. This result may imply that farmers in Classes B and C, while they may be willing to relinquish some degree of control in decision-making, are averse to an increased number of working relationships and the associated potential complexities involved with operating, managing, or potentially unwinding a JV structure involving a larger number of JV partners.

By comparing attribute preferences across farmer classes, a picture begins to emerge regarding potential complementary and conflicting JV structure preferences between and within classes. By each of the 10 possible combinations of LC relationship pairs, conclusions can be drawn about the suitability of potential JV 'pairings' between and within classes (Figure 2).

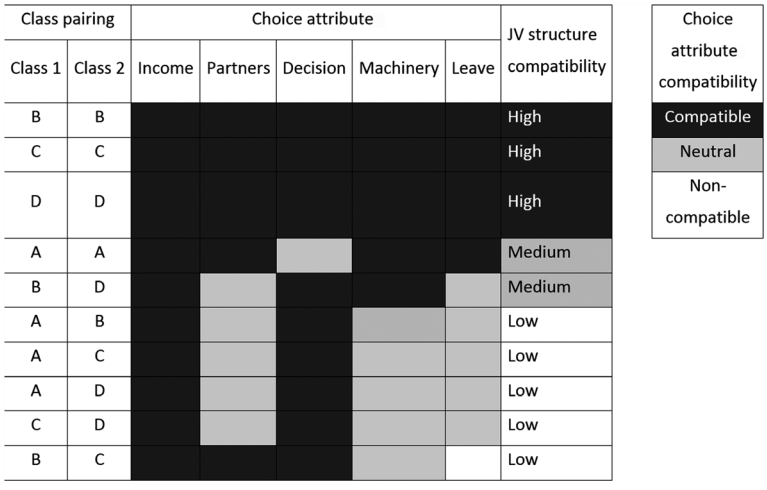

Figure 2 Class pairings and joint venture structure compatibility

To create the compatibility matrix shown in Figure 2, the choice attributes were assessed for each possible individual relationship pairing and rated compatible, neutral or non-compatible. Each attribute within a relationship pair was rated either: (i) compatible, if the JV structure attribute preference between a relationship pair was aligned, complementary, or if within-class preferences were insignificant; (ii) neutral, if one class had a significant attribute preference whilst the other class displayed no significant preference for the same attribute, or if both classes had insignificant preferences; or (iii) non-compatible, if both classes had a significant, but opposing preference for the same attribute. Based on the collective assessments of the five choice attributes, each pair was then allocated a relationship compatibility ranking as a way to assess JV partner potential between classes. Relationship pairs were rated either: (i) High, when all attributes between a pair were rated compatible; (ii) Medium, when at least three attributes between a pair were rated compatible, and no attributes rated as non-compatible; or (iii) Low, when only two attributes were rated compatible, or if any attribute between the pair was rated non-compatible.

Only one attribute pairing (between Classes B and C) was considered non-compatible because farmers in these classes had opposing preferences for the leave attribute. The analysis revealed that the relationship pairings that were rated as 'high' all consisted of farmers belonging to the same class (Classes B, C, and D; consisting of 64.2 per cent). Farmers in Class C (class size of 16.8 per cent) appear a promising partner for a JV with other farm businesses given their willingness for shared decision-making.

Farmers in Class A (35.8 per cent) were slightly more willing to take financial risks to realise higher average returns and disagreed that JV structures would offer flexibility for a reduced workload. These farmers had the highest preference for being a sole or final decision-maker and, as such, will likely be less interested in JV structures. However, the significant preference for shared decision-making suggests that these farmers may engage in a JV if they found the right (passive) investment partner.

The preference heterogeneity predicted in our model remains largely unobserved, and we cannot *a priori* predict what type of farmers will belong to which preference class based on observable socio-demographic characteristics such as age, education, or gender. Only attitudes to risk, having expanded farm area, or agreeing that flexible workload makes JVs attractive were significant in the class membership function. From a policymaker's perspective, the inability to accurately identify a farmer's preference for JV structures based on observable socio-demographic characteristics limits the ability to target policy interventions at a particular farmer socio-demographic group.

Overall, the results suggest that there is not a 'one size fits all' approach to designing JV structures. Therefore, policymakers should focus on fostering and supporting a range of JV structure models that meet the broad needs of farmer population segments.

For farmers interested in the adoption of JV structures, the pool of potential JV partners is diverse and interested in a wide array of JV models. Significant heterogeneity in farmer preferences indicates that the prospect of finding JV partners with matching preferences may be reasonable for most farmers, but this will be highly influenced by the level of compatibility across a range of factors, including financial circumstances, operational, managerial and governance preferences, attitude to risk, long-term goals, personality, farm enterprise alignment, and geographical proximity, amongst others. Farmers may need assistance in identifying and evaluating the suitability of potential JV partners. There could be a role for specialist companies such as Collaborative Farming Australia[2] to bring together compatible farmers and provide advice on the most efficient collaborative business structures. Additional training of existing networks of trusted advisers like Grower Groups or farm agronomic consultants is further needed to facilitate this process. Further support can be provided by federal or state government programs, for example by expanding the scope of the *Farming Together* program[3] to encompass innovative collaborative business structures beyond co-operatives and supply chain collaboration, or by reducing registration fees for JVs of agricultural businesses.

The diversity in farmers' preferences increases the opportunities for identifying compatible JV partners amongst the farmer population. Ultimately, given the complex and multi-faceted nature of adopting a JV, adoption is likely to be limited to a niche of grain growers, with a willingness to trade-off some level of independence, combined with a strong preference to strategically increase the scale, productivity and profitability of their farm businesses over the medium to long term. Within the sector, the owner-operator family farm model is expected to continue to be the dominant farm structure, due to a range of compelling operational, social, and lifestyle factors. However, organisational innovations like JVs, will, over time, become an increasingly important tool in the innovation toolbox given the increasing capital, scale, and productivity growth demands on broadacre grain growers in Australia.

5. Conclusions

There is growing evidence that a combination of scale, management and/or capital constraints is limiting the adoption of productivity-boosting innovations for an increasing number of Australian grain growers (Gladigau 2013). Organisation innovations, like joint venture (JV) farm structures, designed appropriately, may help some farm businesses overcome these constraints and boost their competitiveness. Our study is one of the first to investigate Australian farmers' preferences for JV business models and the first to analyse how preferences might vary for different attributes of JV structures.

[2] https://www.collaborativefarmingaustralia.com/
[3] https://farmingtogether.com.au/

Our analysis shows that there is high variability in farmers' preferences for the attributes of JV structures considered in this study. This highlights the importance of accounting for preference heterogeneity in analyses of farmers' interest in JVs. Understanding what farmer classes exist in the population is important to develop relevant and targeted JV farm business structures.

Our findings suggest that there is an interest amongst the majority of Australian farmers for shared decision-making business models to increase capital and, in some cases, access to machinery and flexible leave arrangements. Given that the pool of potential JV partners is diverse, further research should now focus on how to operationally assist farmers in identifying the most appropriate partnerships based on various business preferences and attitudinal differences between potential partners. As argued in this paper, finding a suitable partner will require not only an alignment of preferences for JV attributes, but compatibility across a range of financial, personal, physical, attitudinal, and operational parameters.

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Appendix

Description of Joint Venture or Collaborative Farming Arrangements in the farmers' survey

For this study, we define a joint venture (JV) or collaborative farming model as a business structure that combines the assets, infrastructure, and staff of two or more farm businesses.

The JV has the following characteristics:

- A JV increases economies of scale as multiple farms are managed as one unit, improving machinery and labour utilisation rates;
- Individual farm businesses retain ownership of underlying land assets, but this land is leased to the JV;
- Machinery is procured and managed by the JV; and
- If required, there is also the option to include additional farmland from third parties via sharefarm or lease arrangements to achieve an optimal operational area.

Two examples of possible JV structures are shown below:
Examples = 40,000 hectare (10,000 acre) joint venture between two farm businesses
(note – optimal operational area will vary from region to region).