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Strategies for integrating farmers into modern vegetable supply chains in Vietnam: farmer attitudes and willingness to accept

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In Vietnam, the development of so-called 'modern' vegetable supply chains is receiving considerable interest amongst researchers and governments. This interest partly stems from the view that enhancements in food safety can be achieved if farmers are willing to adopt supply chains that are often associated with 'western' forms of retailing. Our study investigates farmers' willingness to change to two 'modern' alternatives – a supply model based on cooperatives and another based on investors facilitating the change. Using discrete choice data drawn from 412 farmers, mixed logit models in willingness to pay space are developed that reveal the relative importance of different drivers of change. The paper offers insights that can inform governments about the incentives required to bring about change. In addition, the paper illustrates the novel application of a choice experiment to enumerating the perceived costs of changes in vegetable supply chains.

Key words: contract farming, discrete choice experiment, supply chain management, Vietnam, willingness to pay space.

1. Introduction

In emerging economies like Vietnam, a rise in the middle class has increased the demand for vegetable, dairy and meat products (Godfray *et al*. 2010a,b) and shifted attention to the so-called 'modernisation' of food distribution. A significant motivation in this context is the increased concern of consumers and governments about food safety (Henson and Hooker 2001; Parfitt *et al*. 2010) and the capacity of modern supply chains to better manage quality assurance (Reardon *et al*. 2018). Supply chain management is central to progress on this front (Godfray *et al*. 2010a,b; Manzini and Accorsi 2013), but substantial challenges persist.

First, in many developing countries the vast majority of farms are small and family operated (Fan and Chan-Kang 2005), making the coordination required to cater for modern marketing costly. Second, the trend towards

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global food trade and greater specialisation in food processing puts downward pressure on food prices, with potentially significant negative consequences for smallholders (Shukla and Jharkharia 2013). Finding a path that will allow smallholders to compete in this environment while meeting rising food safety standards is problematic.

One approach for vertically integrating smallholders into modern supply chains is through farmer collaboration (Gulati *et al.* 2007; Biggeri *et al.* 2018). Collaboration can take on different forms (e.g. joint buyer groups; shared farm infrastructure) some of which improve the prospects of farmers obtaining capital and marketing skills (Wang *et al.* 2014; Kilelu *et al.* 2017).

In contrast to the farmer cooperative model, so-called consolidators have also emerged who play important roles in terms of food safety (Caiazza *et al.* 2016). Processors and consolidators invest in systems to secure food supply chains by managing product classification, labelling, traceability and even product recall. These compliance systems are generally integrated with laws and regulatory regimes regarding food safety. Moreover, quality control in the processing system is built to ensure safe regular compliance, and the information flow that results from this type of integration helps ensure food supply chain transparency and enhances supply chain management (Ross 2013). It also increases the understanding of all partners in the chain about the risk of safety failure (Henson and Hooker 2001).

Contract farming has long been viewed as playing an important role in this context. Specifically, contract farming can combine small-scale farmers with more modern food supply chains which are simultaneously associated with improved quality control (Wang *et al.* 2014). Small-scale farmers with low education, poor on-farm infrastructure and limited access to information can benefit from contracting with large professional agribusiness firms. Contract farming can also reduce transaction costs and risk (Barrett *et al.* 2012). However, local farmers often remain sceptical about these benefits. Questions thus arise about the motivators that would encourage farmers to embrace different variants of modern supply chains.

While some empirical studies have focused on how to integrate small-scale farmers into modern supply chains in developing countries (Guo 2005; Masakure and Henson 2005; Costales and Catelo 2008; Miyata *et al.* 2009; Barrett *et al.* 2012; Wang *et al.* 2014), significant gaps in this research remain. Firstly, most studies have focused on the roles of government to encourage farmers involvement in 'western style' supply chains by setting up agriculture hubs and building on-farm infrastructure (Reardon *et al.* 2012). Within these types of studies, there is only limited recognition of the perceptions of farmers and their willingness to voluntarily abandon existing supply arrangements. Secondly, very little is known about the relative importance of different barriers to switching from a farmer's perspective. In part, this reflects the absence of studies where multiple behavioural drivers have been considered simultaneously. Some studies exist on narrow elements of farm production, like 'green' farming (Schulz *et al.* 2014), agro-ecological innovations (Ruto

and Garrod 2009; Blazy *et al*. 2011), agri-environment schemes (Ruto and Garrod 2009) and e-marketing development (Pavithra *et al*. 2018). However, these are of limited use when considering the important questions related to smallholder switching to marketing modes that generate improved food safety outcomes.

This paper adds to the growing literature on farmer adoption of new supply chains by identifying and enumerating the barriers to adopting either a farmer cooperative model or contract farming. The paper itself is comprised of four additional parts. Section 2 is used to provide an overview of the Vietnamese vegetable supply chains and the relationship to food safety. Section 3 is used to present material related to discrete choice experimental design, while the data analysis that derives from choice modelling is provided in Section 4. Concluding remarks and reflections on further research are presented in the final part.

2. The vegetable supply chain in Hanoi, Vietnam

The vegetable supply chain plays a vital role in satisfying a diverse diet in Vietnam, especially in its growing cities. Daily per capita vegetable consumption in Hanoi, for instance, stands at around 290 g. This is amongst the highest in Asia and compares with a global daily average per capita vegetable consumption of 279 g (Wertheim-Heck *et al*. 2015). The traditional vegetable distribution network in Hanoi in 2010 comprised 270 permanent and 113 temporary markets, while the number of supermarkets and convenience stores selling vegetables stood at only 24 (Wertheim-Heck *et al*. 2015). The number of traditional retailers increased sharply to 1,042 in 2014, and there were a significant number of street hawkers selling vegetables (Tu 2014). The number of traditional food retailers would not be problematic but for the absence of means to adequately control the food safety and hygiene standards.

Government efforts aimed at eliminating food poisoning have used a combination of laws, regulations and encouragement of modern retailing (Moustier and Loc 2010). Regardless of these ambitions, data from the General Statistics Office of Vietnam (GSO) reveal that in 2017 alone, there were a reported 3,374 people suffering food-related illness, including 22 deaths (GSO 2018). There are also ongoing concerns about the long-term consequences of breaches of food safety practices.

Amongst the main challenges for vegetable safety control is the limited and ineffective quarantine systems. According to the People's Committee of Hanoi (PcoH), the city has limited capacity to administer quarantine systems, with the large number of retailing markets, including livestock and vegetable markets, informal bazaars, traditional mom and pop stores, making compliance daunting. In addition, in the traditional supply chain, vegetables are usually harvested in the early morning then distributed and sold on the same day. Quality control officers are physically unable to check and trace

vegetable safety on a daily basis (PcoH 2009). Adding to the challenge of quality assurance of vegetables in such markets is the structure of primary production itself. The dominance of smallholders in agriculture and the difficulty of controlling harmful inputs in production is considerable (Wertheim-Heck *et al.* 2015). Given the requirement of 'modern' suppliers to offer only certified products, the retailer must invest significant effort to monitor the supply chain. Perhaps not surprisingly, mechanisms for accomplishing this task across a large number of small-scale farmers remain a work-in-progress.

In an effort to eliminate vegetable poisoning and secure effective quarantine systems, the government has pursued policies aimed at reducing the dominance of traditional markets and expanding modern retail formats, particularly in Hanoi, the capital of Vietnam. Data from the Ministry of Trade indicate that Hanoi had 280 formal and semi-permanent markets and 113 informal markets in 2010. These figures are expected to decrease by 2020 with only 14 permanent markets remaining (Wertheim-Heck *et al.* 2015). To achieve this result, policies are in place that include restriction on building new traditional markets, transforming traditional markets towards 'western style' markets and renovating existing traditional markets (PcoH 2011). Regarding the encouragement of modern supply chains, Hanoi has policies focused on integrating supermarkets into residential apartments or office buildings, developing supermarkets in surrounding areas and developing convenience stores in the street. In 2009, the number of supermarkets that sold vegetables in Hanoi was 23 and this is expected to increase to 200 by 2020 (Wertheim-Heck *et al.* 2015).

A key piece of information missing from this approach is the encouragement needed to bring primary production by smallholders into line with the expectations of a modern supply chain. Understanding the relative influence of different motivations for farmers is critical to this approach. In this paper, we investigate the determinants of the small-scale farmers' willingness to switch to modern supply chain, using a choice experiment.

3. Discrete choice experiment design

Hanoi was chosen for conducting this research because of its prominence in perennial vegetable growing (Soong 2006). The experiment was designed using input from a panel of relevant experts and focus groups with farmers.

3.1 Developing attributes and levels

The Delphi method was initially used to investigate potential scenarios for farmers switching to a modern supply chain and the specific attributes that would be important in this context. The use of the Delphi method to develop and inform choice experiments is relatively rare and emerged, in part, from concerns that choice data do not always relate well to the management options available to experts (Cooper *et al.* 2017). This phase of the research consisted of

25 in-depth interviews with experts from different sectors in Hanoi, including members of government organisations (five), supermarket managers (three), distributors (five), members of nongovernment organisations (two), heads of farmer organisations (six) and academic researchers in agri-food supply chains (four). The experts answered open-ended questionnaires in three separate consecutive rounds. This process had several objectives. Firstly, they aimed to provide an overview of vegetable distribution across the city of Hanoi. Secondly, it was expected to enhance the expert's own knowledge of the farmer's roles in the vegetable supply chain. Finally, it was presumed that this knowledge would assist in identifying appropriate scenarios, leading to the integration of smallholders into modern supply chains.

Overall, the panel noted that farmers in Hanoi can integrate into the modern supply chain in two basic ways: by becoming members of a farmers' association or cooperative; and by joining forces with investors by signing a farm tenancy agreement. The first method implied that farmers who are part of an association or cooperative can gain contracts with supermarkets and convenience stores, as well as access technical knowledge by attending training sessions supervised by technicians and local officers. Furthermore, joining a farmers' association or cooperative makes it easier for farmers to gain support from the government at different levels, because government policy encourages farmers to produce safe vegetables by means of certification. The second method by which farmers could integrate involves investors and farm tenancy contracts. Here, investors supply and manage most inputs on the farm, and the farmer becomes a supplier of land and labour only. Small-scale farmers in this situation would gain a stable, fixed income from a farm lease, and could work on their farm and receive a fixed monthly salary. Investors could consolidate small-scale farms into large production units and gain advantages through mechanisation and producing a high-quality product at lower cost whist also controlling for food safety.

The final step for identifying choice attributes and levels in this experiment involved farmer focus groups, which were used to test the information offered by the expert panel and to assign levels. This sought to ensure that the experiment was 'real' from the farmers' perspective and this approach gave rise to various attributes and levels summarised in Table 1.

Although elements of the cooperative model and investor model differ, it is necessary to identify common attributes for conducting a choice experiment across each of the supply chain options. The overarching attributes identified by the Delphi and focus groups deal with risk, control/responsibility and rewards that attend each supply chain. In the context of the latter, a one-off payment from investors to farmers ranged from US$ 50 to US$ 400, accompanied by the prospect of an ongoing annual payment. In the case of the cooperative model, there is no prospect of an ongoing payment, rather a larger one-off payment was considered more feasible. The over-riding consideration was to make the levels both plausible and yet sufficiently varied to generate a range of responses from participants.

Table 1 Attributes and levels for choice experiment

Attribute	Description	Levels
The type of supply chain	The characteristics of each alternative are presented below based on control, responsibility for land, usufruct of land, responsibilities and risks: 1. *Investors (as vehicle for supplying modern chain)* Agreeing to a farm tenancy contract with investors. This would mean: • the farmer is responsible for providing labour if there is a labour hiring contract • there is no government support for the individual farmer • the investor takes sole responsibility for price; quantity; quality; land management; seed/fertiliser/water • the investor has the risk of market exposure • the investor will gain surpluses from sale of output and speculative gains from land management • the farmer has income surety during a fluctuating market • the farmer has the risk of no super profits from output; no speculative gains from land; default by investor 2. *Farmer co-op or association (as vehicle for supplying modern chain)* Agreeing to be part of a farmers' association. This would mean: • the farmer is responsible for land management, labour, seed, water • the co-op and farmer share the responsibility for price; quantity; quality • the farmer receives a priority share of the benefit from the co-op contract with supermarkets • the farmer receives upfront government support to help establish their relationship with the co-op • the farmer receives surplus from sales and keeps the speculative gains from land • the co-op receives some surplus from sales • both the farmer and the co-op share the risk of market exposure and default by others	Investors: Yes; No Farmer co-op: Yes; No Status quo – individual farmer: Yes

Table 1 (*Continued*)

Attribute	Description	Levels
	3. *Individual farmer (traditional supply channel)* Agreeing to the traditional supply channel would mean: • the farmer takes sole responsibility for price, labour, quantity, quality, land management, seed, water • there is no government support for the individual farmer • the farmer has the risk of market exposure • the farmer will gain surpluses from sale of output and speculative gains from land	
Duration (years)	Contract duration for land rent. The farmer relinquishes control of the land	Investors: 5; 10; 15; 20 (years) Farmer co-op: 0 Individual farmer: 0
Payment	A guaranteed, single (i.e. one-off) payment made at the start; • In the case of an 'investor' contract, the payment is for land use only • In the case of a 'farmer cooperative', the payment is from the government to support involvement in the cooperative	Investors: US$ 50; US$ 100; US$ 150; US$ 200 Farmer co-op: US$ 300; US$ 400; US$ 500; US$ 600; US$ 700 Individual farmer: 0
Ongoing payment	The contract assumes that the farmer will be paid for the hire of their labour with insurance for 12 months (rate determined and reviewed annually based on information from the local labour market). The investor has the option of either hiring you (if you wish) or others	Investors: 0; 1 Farmer co-op: 0 Individual farmer: 0

3.2 Generation of choice sets

The attributes and levels described in Table 1 resulted in an orthogonal fractional factorial design, and 18 choice sets for the pilot survey were generated using Ngene software (ChoiceMetrics 2014). It was considered appropriate for each participant in the pilot to face six choice sets, so the set of 18 were blocked into three, which were randomly allocated to participants. Each choice set included two alternatives. Alternative one was the modern supply chain (becoming a member of a farmers' association or cooperative, or contracting with investors) and this was paired against the status quo, called 'stay with traditional supply chain'. Appendix S1 and S2 show an example of two choice sets and respondent reference sheet, respectively. In the pilot phase, 60 farmers provided information and completed the questionnaires.

Stata 13.1 (StataCorp 2013) was subsequently used to estimate a conditional (fixed effects) logistic regression and the priors estimated from the model were used to generate a D-efficiency design, for the main survey, with Ngene software. This effectively forces options onto the design that optimise efficiency (Ryan *et al.* 2012). This gave rise to 24 choice sets in total and six choice sets were allocated per participant such that four blocks or versions of the survey were ultimately distributed for the main survey. Socio-demographic data were also collected.

4. Choice model estimation and interpretation

The purpose of the choice model estimation is to evaluate the relative importance of aspects of modern supply chains in shaping decisions by farmers. Stated decisions to switch or stay with the traditional supply chain were modelled using random coefficient logit models (mixed logit model – MXL) in willingness to pay (WTP) space. Subsequently, parameter estimates were used to investigate farmer's willingness to accept (WTA), a useful piece of information with policy implications. More specifically, this shows the inducements that would need to be offered to encourage a voluntary shift to different types of modern supply chains.

In this research, WTA is the minimum amount of money that a farmer is willing to accept to switch to a modern supply chain. An important consideration in design is the basic distinction between WTP versus WTA (Horowitz and McConnell 2002). Statistically, the simplest form of WTP or WTA calculation is the ratio of the coefficient for one attribute to the price attribute. The distinction between WTP and WTA has proven particularly problematic for some applications of choice modelling (Plott and Zeiler 2005). Theoretically at least, a rational individual's WTP and WTA should be equal for the same change in utility. However, in practice WTA is usually greater than WTP due to a range of endowment and similar effects (Horowitz and McConnell 2002). This has led some practitioners to advocate the use of WTP as a default in choice experiments (Dupraz *et al.* 2003). However, in the

case of this study, there are strong grounds for employing WTA. More specifically, since the experiment requires the respondent to carry some costs associated with a change in supply chain, a WTP format is likely to be implausible (i.e. specify the monetary attribute as an amount that farmers had to pay to join the modern marketing scheme) and result in incentive incompatibility problems.

4.1 The random coefficient logit models in WTP space

Based on two important assumptions about consumer behaviour (e.g. Lancastrian consumer theory (Lancaster 1966) and random utility theory (McFadden 1974)), the latent utility of farmer n in choice model can be divided into two main components: the observable component $V_i\ (X_i\beta)$ and a random error term ε_{nji}. If U_{nji} represents the utility of farmer for choosing type of supply chain j ($j = 1$ for traditional supply chain; $j = 2$ for contracting with investor; and $j = 3$ for joining in farm cooperative or association) in choice set i, then utility can be expressed as follows:

$$U_{nji} = X_i\beta + \varepsilon_{nji} \tag{1}$$

The observable component $V_i = (X_i\beta)$ in the MXL can be specified as a function of monetary (payment) attribute (P_{nji}) and nonmonetary attributes (NP_{nji}) including duration, option of ongoing payment and type of supply chain. The utility takes the form specified in Equation (2).

$$U_{nji} = \alpha_n P_{nji} + \beta_n \mathrm{NP}_{nji} + \varepsilon_{nji} \tag{2}$$

where α_n and β_n are the coefficients for payment and the other attributes of choice set. The MXL model specifies the error terms ε_{in} as independently distributed across observations. Following Train and Weeks (2005), the utility in WTP space model can be rewritten as:

$$U_{nji} = \lambda_n P_{nji} + (\lambda_n w_n)\mathrm{NP}_{nji} + \varepsilon_{nji} \tag{3}$$

In the WTP space model, the distribution for the WTP is specified directly to avoid unusual distributions for WTP (Train 2009). The coefficients of attributes in the WTP space models can be estimated by using maximum simulated likelihood (Hole 2007).

4.2 Respondent and farm profiles

In the main survey, participants were chosen randomly from a vegetable farmer contact list provided by the local authorities. An invitation to participate in the study was sent to 800 individual farmers located in Hanoi across 11 districts of Hanoi City between October 2015 and January 2016. A

total of 427 vegetable growers agreed to participate in answering the face-to-face questionnaire. However, following administration 15 responses were partially incomplete, with some items left unanswered and these questionnaires were set aside. This resulted in a total of 412 in-person interviews that represents a total response rate of 51.5 per cent relative to the initial invitations. This was equivalent to data from 4,944 observations for the choice model analyses using the MXL model in WTP space.

Farm and respondent characteristics varied widely in terms of the sample demographics in the database. Table 2 shows that data were collected mainly from female farmers (73.54 per cent). This is not unexpected given the feminisation of smallholder agricultural is commonplace in Vietnam. Farmers aged 41–50 and 51–60 made up 36.17 per cent and 32.04 per cent

Table 2 Demographic and respondent data

Demographic (CODING)	Frequency	%
Farm location (AREA)		
Urban	16	3.9
Rural	396	96.1
Total	412	100
Age of respondents (AGEGROUP)		
Up to 30	15	3.64
31–40	68	16.50
41–50	149	36.17
51–60	132	32.04
61–70	48	11.65
Total	412	100
Mean = 49.18; SD = 0.499		
Gender of respondents (GENDER)		
Male	109	26.46
Female	303	73.54
Total	412	100
Number of years involved in vegetable production (YEARINVO)		
1–10 years	116	28.22
11–20 years	121	29.44
21–30 years	109	26.52
31–40 years	55	13.38
41–50 years	10	2.43
Total	412	100
Mean = 21.29; SD = 0.580		
Annual household member total income (INCOME)		
Poor	48	11.65
Marginally poor	56	13.65
Average and more	308	74.76
Total	412	100
Mean = US$ 1,045; SD = 40.68		
Farm size (FS)		
Farm size from <0.072 ha	112	29.61
Farm size ≥0.072 and <0.144 ha	172	41.75
Farm size ≥0.144 and <0.216 ha	71	17.23
Large farm size ≥0.126 ha	47	11.41
Total	412	100
Mean 0.15 ha; SD = 0.005		

of the cohort, respectively. Farmers had an average of 21.29 years of experience in growing vegetables, suggesting that farmers in the sample are highly experienced. The majority of farms (96.1 per cent) were located in rural areas leaving around 4 per cent in urban areas. The latter often results from rapid urbanisation, where surrounding vegetable farms have been displaced from the city centre to make way for infrastructure projects such as buildings and roads. Based on the total income classification in Decision 59/2015/QD-TTg from the Vietnamese Prime Minister, data from the survey suggest that about 25 per cent of farmers are classified as poor or marginally poor, with an income of less than US$ 545 per person annually in rural areas and US$ 709 per person annually in urban areas. The average size of the farms surveyed was quite small: 0.15 ha, lower than the average size of Vietnamese farms (approximately 0.2 ha per capita) (Vu *et al*. 2012).

Ideally, a comparison of the sample with the farming population in general would be conducted. Regrettably, access to reliable comparison data is not feasible in this case, beyond the general observations above about income and farm size.

4.3 Mixed logit model estimates in WTP space

A WTP space model was applied to the discrete choice data. Stata 13.1 was used to estimate a WTP space model, which is presented in Table 3. The results presented derive from the Halton draw method with 500 random draws. This number of draws secured a stable set of parameter estimates and underpins WTP/WTA calculations (Train 2000). The Payment coefficient is assumed to be lognormally distributed, to ensure that the marginal utility of money is positive. All other parameters are assumed to be normally distributed. A full correlation structure across parameters is estimated.

Table 3 Willingness to pay (WTP) space model estimates

Attribute variable	Coefficient	Standard Error
Payment†	−4.34*	0.13
Duration	−4.24*	1.48
Option of ongoing payment	145.95*	19.16
ASC1: farm cooperative or association	−29.61	53.09
ASC2: contracting with investors	−339.53*	25.91
Standard deviations		
Payment	0.82*	0.15
Duration	7.69*	2.05
Option of ongoing payment	160.27*	28.39
ASC1: farm cooperative or association	489.26*	88.27
ASC2: contracting with investors	356.93*	30.13
	LL = −1,142.691	AIC: 2,325.382
	$P > \chi^2 = 0.0000$	BIC: 2,455.501

Note *Significance levels of 1% level. †The coefficients for Payment are the mean and standard deviation of the log of the WTP coefficients.

The means for each of the attributes (duration, option of ongoing payment and ASC2) proved significant at the 1 per cent level. The sign of coefficients was largely as expected with farmers having a negative attitude towards the duration of the contract, when contracting with investors. Farmers had a positive preference for labour hire contracts with investors, as might be expected. The negative sign of the ASC2, associated with the Investor option, indicates that farmers were averse to switching to contracts with investors. The ASC1 coefficient (associated with the co-op) is insignificant at the 5 per cent level, implying that, on average, farmers are indifferent towards farm cooperatives and the status quo.

The standard deviation of each random coefficient, duration, payment, option of ongoing payment and alternatives, is highly significant, indicating that preferences vary across farmers. From the magnitudes of the standard deviations relative to the mean coefficients, the WTP for the Duration attribute has a mean value of – US$ 4.2 per year, but the estimated standard deviations of 7.6 imply that 29.1 per cent of the sample have positive preferences for increased duration. Put differently, 70.9 per cent farmers preferred short-term contracts, while 29.1 per cent of farmers preferred to lock in long-term relationship with the investor. The results also revealed that 81.9 per cent of farmers prefer providing labour input in the investor contract mode. Surprisingly, 18.1 per cent farmers are willing to sign the contract with investors without any negotiated and specified terms and conditions.

The alternative specific constants associated with the different supply chain types give an indication of how large a payment is required to induce them to switch to the modern supply chain. For the cooperative alternative (where there are no additional attributes of the contract) on average that value is zero, but there are large variations around that. Some farmers would require payment, but strikingly, the results suggest that some farmers would be willing to pay to join a cooperative. This result has to be treated with some caution, as no farmer was asked to pay in the design, but it does suggest that there is a latent demand for cooperatives. On average, they would require US$ 339 to participate in an investor led contract, and there is a negligible part of the distribution implying they would be prepared to pay to join the contract. The amount is then moderated by the attributes of the contract: as noted above, more is required the longer the contract, and less if there is an option for ongoing hired employment. In this case, socio-demographic variables, such as age and income, did not prove to have a significant influence on supply chain preferences.

Table 4 reports the covariance estimates for the random coefficients. The negative correlations between the ASC for contracting with investors and the ongoing payment imply that those who require a higher payment to accept a contract with investors also value the ongoing payment more highly (note the reversal in sign in the mean parameter estimates). Those who require higher payments for the investor contract also require a higher payment for the co-op option also.

Table 4 Covariance estimates for normally distributed random coefficients

	Duration	Option of ongoing payment	ASC: Contracting with investors
Option of ongoing payment	348.7902		
ASC: Contracting with investors	−224.42	−35,710.83*	
ASC: Farm Co-op or association	−859.64	10,745.57	89,408.88*

Note *Significance at the 1% level.

5. Conclusions and policy implications

This study empirically investigated the relationship between farmers' behaviour and their willingness to change from their current supply chains. The results suggest that, on average, farmers are indifferent towards farm cooperatives. To understand this result, it is necessary to return to the setting of the choice tasks. In the farmer cooperative, there is ongoing uncertainty about the outcome of the vegetable business. Farmers are still responsible for providing land, labour, seed and water, and face the risk of market exposure while having to invest more money to renovate production processes and adapt to supermarkets' requirements for vegetable quality and safety. This payment can therefore be viewed as a form of transaction or switching cost (the cost of accepting uncertainty with the potential for a negative outcome when dealing with a new buyer). The distribution of choices for the co-op choice sets only was examined to identify how the proportion of respondents who would select the option changes as the payment amount varies. With payments of US$ 700 and US$ 300, in 89.11 per cent and 66.34 per cent of choice occasions the co-op option was selected. This figure only falls to 56.31 per cent when payment is US$ 100, which suggests that a large number of farmers would choose the co-op option at small values of payment. It also confirms the idea that, within the context of the study, some farmers are very pro-coop. This result highlighted the scope for government to encourage farmer integration into the modern supply chain. Government could offer some subsidies along with one-off payment such as farm inputs for seed or credit supports for new farm machinery and facilities for farm cooperative association. This is not to advocate for a subsidy to farmers per se. Rather, given the public good nature of improved health safety, these data provide some evidences of what might constitute a successful intervention, if deemed appropriate.

The results of the choice experiment also indicate that farmers have a negative preference for farm tenancy contracts of longer duration. On average, farmers perceive this as a barrier to switching supply chains. In Vietnam, especially in larger centres like Hanoi or Ho Chi Minh city, rapid urbanisation has resulted in a boom in projects focused on public infrastructure, residential living developments, factories and industrial zones. This has led to farm land being recalled and converted to other

uses. When this happens, farmers receive compensation from the government of between US$ 2,880 and US$ 4,320 per 360 sqm (declared in Hanoi's Decision number 96 dated 2014). Arguably, this compensation affects farmers' willingness to switch supply chains at least in terms of the duration attribute, since an investor contract relinquishes claims on compensation. In contrast, investors generally prefer longer contracts to cover the high sunk costs of change.

The complexity of choices for farmers is also illustrated with their WTA for ongoing employment/labour contracts. As already noted, these values substantially outweigh the negative impacts from a loss of farm tenure. On the basis of the mean data on hand, a 1-year guarantee of an ongoing payment would effectively 'compensate' farmers for a decade-long loss of land control. Again, these data should not be interpreted as supporting one modification to supply chains over another. Rather, they indicate the quantum of funds that need to be available at the mean to generate significant adjustments in the sector.

Throughout the paper, we have endeavoured to highlight the motivation, on the part of government, for encouraging a shift to modern supply chains. We have shown that a strong desire exists to modernise vegetable supply chains because this is related to improved quality and public health and safety outcomes. Two options were revealed as feasible scenarios for change: a cooperative mode, where farmers continue with greater control, and an investor model characterised by somewhat less autonomy for farmers.

In both cases, the data collected and analysed show that change is not viewed as costless by farmers. In the case of the cooperative model, a one-off payment could potentially shift a significant number of farmers to this approach. Government support might also involve some different form of subsidies. In the case of investors, shortening the duration of the contract and offering ongoing payments can encourage farmers to switch. Importantly, these adjustments need not be similar, insomuch as the preference for ongoing payments appears stronger than the disincentives from losing control of land.

In sum, the data support the use of nuanced approaches to bring substantial changes to supply chain arrangements.

There are clearly several limitations to this research and areas worthy of further investigation. The empirical components of this work rely heavily on initial insights offered by the expert panel, and this has some bearing on the ultimate findings. In practice, there are multiple types of contract farming with different criteria, such as management-provision contracts, market specification contracts, resource-provision contracts, procurement contracts and total contracts. In this study, we have focused on only two scenarios to make the inquiry manageable. However, offering nuanced contracts that lie between these alternatives could generate different results. The extent to which attitudes differ towards other forms of contract farming deserves further study.

Several additional areas for future research also emerge from this work. First, in line with the management implications of the scenarios, the true extent of farmer involvement in the modern supply chains could be mapped to gauge changes over time. Second, mapping heterogeneity in farmers also requires attention. This could be done by investigating a number of latent classes in the population and simultaneously identifying class sizes and farmer profiles therein. Third, additional analysis using a latent class model might allow the development of a greater understanding of the farmer profiles that match behaviours at a practical level. Regardless of these limits, this study sets a firm foundation for further investigation. Finally, the development of additional research techniques beyond choice modelling that cater for contextual factors offers promise.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article:

Appendix S1. Example of choice set presentation.

Appendix S2. Reference sheet (cheap talk script).