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A transaction cost analysis of Malaysian dairy farmers' marketing channel selection

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Abstract

In order to meet increasing demand and boost self-sufficiency, Malaysia wants to strengthen the production and marketing of domestic dairy products. This study aims at explaining Malaysian dairy farmers' marketing channel selection based on transaction cost theory. A multivariate probit analysis is used to explain 200 farmers' selection between three non-mutually exclusive marketing channels: through (i) the government, (ii) direct selling or (iii) intermediaries. Our results highlight the dependency among the market channel choices and identify the following influential factors: price expectation, delay of payment, trust in buyer, price fluctuation, price expectation and provision of farm services.

Keywords: Marketing channels, transaction costs, multivariate probit, dairy farmer, Malaysia

1 Introduction

After the Asian financial crisis hit in 1997, the Malaysian government used the National Agro-food policy 2011-2020 (DAN) to focus on ensuring sustainable production for food security by reducing the number of imported dairy products and strengthening the marketing of local dairy products. The challenge is that Malaysia relies heavily on imports for dairy product to satisfy its domestic demand. This dependency causes a disadvantage to local dairy farmers, who are unable to sell their fresh milk at a competitive price. Therefore agricultural marketing for smallholder farmers plays an important role to achieve goals of food security, poverty alleviation and sustainable agriculture (Altshul, 1998).

Many studies have scrutinized marketing channels choice by farmers. Identifying the factors influencing marketing channel choice, can be considered as a strategy to protect the optimal level of investment and maximize profits (Soe et al., 2015). Transaction cost theory can be used to understand the forces shaping channel structure (Klein et al., 1990). Hobbs (1996) identified the transaction costs as factors with a significant impact on marketing decision-making.

Dairy milk is a highly perishable product without either cold storage or fairly immediate market access and hence is associated with high transaction costs. Such conditions normally subject producers to limited marketing flexibility as they are often in an unfavourable bargaining position (Jaffee, 1995). In recent years, research on Malaysia's dairy sector has been emphasizing on the constraints for farm production and husbandry such as milk quality (Chye et al., 2004), high input costs (Wells, 1981) and unsuitable dairy cows for tropical weather (Boniface et al., 2007). However, other factors that could significantly contribute to higher incomes for farmers such as marketing channel selection have been neglected thus far.

The main objective of this paper is to investigate marketing factors influencing dairy farmers' selection of milk marketing channels in Malaysia based on a transaction cost approach. There is still a lack of studies that address the marketing of fresh milk to understand the Malaysian dairy sector as it currently stands (Sim and Suntharalingam, 2015). It is essential to examine the transaction costs that may affect the choice of marketing channel to enhance the marketing performance Malaysian dairy farms. This is especially relevant for smallholder farmers, who operate in a difficult environment with poor infrastructure that is lead to higher transaction cost. Farmers could use the information from this study to decide the marketing channel that give more profit. The results also could be used by extension officers to advise farmers on proper marketing channel. Policy maker would also use this

information to amend existing policies in designing an improving marketing channel as motivate farmers to access high value markets.

2 Malaysian Dairy Farming Marketing Channel

Malaysian dairy farmers have three marketing channels to sell their milk: selling (i) to the government through milk collection centres, (ii) directly to the consumers/traders and (iii) through intermediaries. The government, as the main buyer of milk, purchases fresh milk from producers based on graded milk prices at the contract price, then markets the milk through the Dairy Industry Service Centres (PPIT). The contract, however, does not restrict the producers from selling their milk to other buyers so consequently, there are multiple markets available to the producer (Boniface et al., 2012). The PPIT provides a marketing channel for the dairy farmers and operates as a consultant that gives various incentives such as centralised milk collection and distribution facilities, some rural credit and milk subsidies. In our data survey, 171 out of 200 farmers sell their milk to PPIT. Usually farmers send their milk in the morning and in the evening to the nearest PPIT by their own transportation. The sample of milk will be sent out for quality assessment and then graded. The price will be determined based on the grade and ranges from MYR2.45 (EUR0.54) to MYR2.65 (EUR0.58) per litre depending on the region. The price offered by PPIT rarely fluctuated and can be constant within a year. Because PPIT offers various facilities and guidance, farmers prefer to sell their milk to PPIT even though they will get lower price. The PPIT marketing channel can be considered as the formal market for selling dairy milk in Malaysia.

Farmers can also sell their milk directly to consumers and private traders; which we categorize as the informal market. The farmers who sell their milk to private traders can get a higher price compare to the PPIT. The price range is between MYR 2.7 (€ 0.59) to MYR 4 (€ 0.88) per litre. The buyer will collect the milk at the farm, therefore, the farmer will not incur any transportation cost of delivering milk. The buyer is willing to pay a higher price if the milk has a good taste and appearance. It is important to note, that under the direct selling marketing channel, buyer and seller generally have an informal (oral) agreement without any written contract. The drawback of this informal agreement is that the agreed transaction can unexpectedly be changed. Once an agreement is terminated, more time is required to find new buyers for the milk. However, the advantages of this marketing channel are that the farmers can negotiate a reasonable price and that they receive immediate payment from the buyer. From our data survey, 105 (52.5%) of farmers sell their milk to this marketing channel.

Around 44 (22%) of the farmers from data survey prefer to sell their milk to restaurants, hotels or processing firms, which we label as the intermediaries channel. This channel may offer the highest price of milk among other channels, however, the farmers have to deal with strict requirements that are not easy to fulfil. The price range is MYR 3 (€ 0.66) to MYR 5 (€ 1.10) per litre. For restaurant and hotel, they might request a certain amount of milk for everyday uses. While, for processing firms, they might require a large amount of milk. The processing firm will also buy the milk from PPIT but the price is unknown. The farmers will incur a transportation cost to send their milk to the intermediary buyers.

3 Conceptual Approach

There have been several approaches to study the selection of marketing channels (including financial, microeconomic, managerial and behavioural approaches), of which the transaction costs approach has been the most influential stream (McNaughton, 1999). In this study, we assume that the choice of different marketing channels, as well as their simultaneous use is led by transaction costs in addition to farm and farmers' characteristics. Williamson (1979) defines transaction costs as a trade-off between the costs of coordination within an organization and the costs of transacting and forming contracts in the market. Coase

(1937) was the first to discuss about the decision whether to have a transaction within a firm or in the market place will be determined by the transaction costs. Building on Coase's work, Hobbs (1997) classified transaction costs into information, negotiation and monitoring or enforcement costs. Transaction costs arise from the role of *ex ante* assessment which includes costs of information gathering, negotiation and decision-making. *Ex post* assessment, on the other hand, includes the costs of monitoring and enforcement, costs of misalignments and maladaptation of transactions that drift out of agreed specifications or alignment, and costs of dispute resolution (Rao, 2002). According to Hobbs (1997), transaction costs are difficult to measure. So, they must be identified and defined before obtaining the appropriate measurements. Following previous studies such as Gong et al. (2006), Hobbs (1997) and Shiimi et al. (2012), we divided the transaction costs into three categories which are: (i) information costs, (ii) negotiation costs and (iii) monitoring costs. We also added farmer and farm characteristics as control variables. These control variables can also reflect the transaction cost aspects. The theoretical expectation for each category will be explained below.

Information costs

Information costs arise *ex ante* to an exchange and include the costs of obtaining price and product information and the costs of identifying suitable trading partners (Hobbs, 1997). In this study, information costs is composed of price information and price fluctuation. Before deciding which marketing channel to use, dairy farmers must determine the expected price of milk. This, incurs information cost and takes time to obtain the *price information*. It also depends on the availability of information on market price. Gong et al. (2006) and Hobbs (1997) argued that the cost of accessing price information depends on the extent to which market information is readily available to farmers. A large *price fluctuation* indicates that producers may capture a small proportion of the eventual price (Gong et al., 2006).

Negotiation costs

Negotiation costs are the costs of physically carrying out the transaction and may include commission costs, the costs of physically negotiating the terms of an exchange, and the costs of formally drawing up contracts (Hobbs, 1997). These are costs that arise while transactions are actually taking place. Negotiation cost is measured by the delay of payment and price expectation. The *delay of payment* occurs when milk are sold and payment is not received simultaneously Gong et al. (2006).

The *price expectation* can also be considered as negotiation costs when farmers try to negotiate with the buyers to get the price close to their expectation. The average price received or paid is expected to be inversely proportional to the transaction costs involved. For sellers, the transaction costs will be reflected in lower prices which they receive due to high transaction cost (Key et al., 2000).

Monitoring costs

Monitoring or enforcement costs occur *ex post* to a transaction and are the costs of ensuring that the terms of the transaction, for example, quality standards or payment arrangements, are adhered to by other parties to the transaction (Hobbs, 1997). The monitoring costs considered in the study are trust in buyer and farm services. *Trust in buyer* captures the opportunity costs of mobilising the producer's time and efforts against the grading and pricing information asymmetry problem between buyers and sellers (Ndoro et al., 2015).

Farm services refers to technical support and assistance provided by buyers to the farmers. It will reduce the monitoring cost in terms of reducing farmers' effort due to the service that the buyers has provided.

Farmers' socioeconomics and farm characteristics

We hypothesize that farmers' socioeconomics and farm characteristics (age, experience, education, household size, type of farm, herd size, labour, farm size, finance from government and off-farm employment) will influence the marketing channel choice in Malaysian dairy farming.

Age Generally, PPIT will help the farmers who just started their business. Young farmers who have less experience in marketing, might need the assistance such as veterinary advice or marketing strategies. Therefore they are more likely to choose PPIT, while older farmers are expected to prefer the direct selling marketing channel.

Experience increases confidence in business and also in marketing. Likewise, as farmer experience in dairy farming activities increases, they are more likely to choose direct selling or intermediaries marketing channel. They might prefer the market reliability and a comparatively high price offered by the direct selling marketing channel. Less experienced farmers will more likely choose the PPIT marketing channel.

Education may affect a farmer's choice of marketing channel. It is expected that farmer with higher education are likely to prefer intermediaries marketing channel which offers a good price. These farmer have an ability to gather up-to-date market information and price information. They are also more knowledgeable to understand the requirements and procedure set by the intermediate marketing channel. On the other hand, farmers who went to primary school might prefer to sell their milk to the PPIT or the direct selling as these marketing channels involve less requirements and require fewer documentation for the transaction.

Household Size provides the majority of labour for most farming households in Malaysia. Farms with a large number of household members are likely to choose the PPIT marketing channel to guarantee and secure income to feed their household members, rather than seek for the higher price in other markets and run the risk of unsold leftovers.

Type of farm There are two types of dairy farming systems commonly practiced in Malaysia: an intensive system and a semi-intensive system. In the intensive system the animals are confined and provided with cut-and-carry harvested forages whereas in the semi-intensive system the animals are allowed to graze freely. Intensive farmers are more likely to choose PPIT as they are more likely to spend a lot of time on farming activities. This condition makes farmers having less time available to look for buyers in the direct selling marketing channel.

Herd size A higher number of cattle enables farmers to produce more milk. An increase in milk production encourages farmers to choose PPIT because they are guaranteed of milk sales because PPIT will accept any amount of milk in one time. However, the larger the herd size, the stronger the bargaining power of farmers. As farmers' bargaining power increases, which is decrease negotiation costs, they will prefer to use the direct selling marketing channel as their buyer (Gong et al., 2006).

Labour Having more workers gives a reason for farmers to sell their milk to the direct selling marketing channel. Because most of the farming activities would be done by labour, farmers have more time to look for the potential buyers under the direct selling marketing channel or the intermediaries marketing channel.

Land size Feder et al. (1985), considers land size as a surrogate to wealth and hence it would be positively associated with market channel choices especially the PPIT channel.

Finance from government This study assumes farmers who receive an incentive from the buyer such as financial support or technical training, are more likely to be loyal to their buyer and this may affect long-term relationship. This said, farmers are more likely to choose PPIT,

if they receive an incentive from the government. In contrast, farmers are likely to choose direct selling and intermediaries if they have no relationship with the government.

Off-farm employment We hypothesized that farmers with off-farm employment are likely to choose the PPIT channel. This is because PPIT could accommodate their bulky milk and in turn give them a chance for undertaking other activities. On the other hand, farmers without off-farm activities have more time to look for a different buyers to deal with under direct selling marketing channel.

4 Analytical Approach

As farmers select one or a combination of different marketing channels that provide them the fewest transaction costs, we use a multivariate probit (MVP) regression model. The model allows for simultaneous choices, accounting for situations in which farmers simultaneously use more than one marketing channel (Baskaran et al., 2013). Following Cappellari and Jenkins (2003), the model can be represented by:

$$Y_{ij} = X_{ij}\beta_j + S_i\gamma + \varepsilon_{ij}, \quad (1)$$

Where Y_{ij} are binary choice (yes/no) variables reflecting the marketing channel choices (j = PPIT, direct selling or intermediaries marketing channel) of farmer i . It is assumed that farmer i has a particular marketing channel ($Y = 1$) if $Y_{ij}^* > 0$ and does not use that marketing channel ($Y = 0$) if $Y_{ij}^* \leq 0$. β_j is a set of coefficients that reflect the impact of changes in the vector of marketing channel-specific explanatory variables X_{ij} on farmers' choice toward marketing channel j . X_{ij} includes information costs (price information, price fluctuation), negotiation costs (payment delay and price expectation) and monitoring costs (farm services and trust). S_i represents a vector of farm/farmer i specific control variables: age, experience, education, household size, type of farm, herd size, total labour, farm size, finance from government and off-farm income. ε_{ij} ($j = 1, \dots, M$) are random errors distributed as a multivariate normal distribution.

The MVP model estimates the parameters β_j and the variance covariance matrix of the multivariate normal distribution of the error terms. ε is a random errors distributed as multivariate normal distribution with zero conditional mean and variance normalised to unity, where $\varepsilon \sim N(0, \Sigma)$, and the covariance matrix Σ is given by:

$$\Sigma = \begin{bmatrix} 1 & \rho_{12} & \rho_{13} \\ \rho_{21} & 1 & \rho_{23} \\ \rho_{31} & \rho_{32} & 1 \end{bmatrix} \quad (2)$$

5 Data Description

Data were collected by personal interviews using a combination of closed questions and Likert scales with a 5-point format. 200 respondents were randomly selected from four regions based on the most representative milk production: Johor (43), Negeri Sembilan (54), Selangor (42) and Melaka (61). Dairy farmers were traced with the assistance of the Department of Veterinary Service (DVS), which provided name list of the farmers in each region. The interviews were carried out among dairy farmers between February and June 2015.

Descriptive statistics as well as variable definitions, are reported in Table 1. The dependent variables in this study are binary (yes = using the channel, 0 = not using the channel) for each marketing channel. From the survey, 86% (n=171) of farmers sell to PPIT, 22% (n=44) sell to intermediaries and 53% (n=105) sell directly. The independent variables in this study may be divided into two groups (see Table 1). The first group includes all

transaction cost variables, which are information, negotiation and monitoring costs. All these variables were collected as 5-point ordinal variables (An example question is “I am well informed regarding the price of milk”, the farmer can then choose only one answer: 1-strongly not agree, 2-not agree, 3-neither agree nor disagree, 4-agree and 5-strongly agree). For this study, we converted all ordinal variables to dummy variables (0 for strongly not agree to neither agree nor disagree and 1 for agree and strongly agree) in order to make model estimation more tractable.

As farmers did not answer the transaction cost questions for marketing channels they did not use, we were left with multiple missing values. As these missing values drastically reduce our sample size available for estimation, we made predictions for these missing values using bivariate probit models to overcome this problem. In this approach, we used the individual marketing channel-specific transaction cost variables with missing variables (price information, price fluctuation, delay of payment, price expectation, trust in buyer and farm service) as a dependent variable and farmer-specific socioeconomic variables (age, experience, level of education, household size, herd size, type of farm, finance from government, farm size and total labour) as independent variables. Using the resulting estimated models (18 models in total: 6 TC variables specific to 3 different marketing channels), we predicted the missing values for our independent variables in our main analysis. We made a prediction of the value of six transaction cost variables for 29 farmers in PPIT, 156 farmers in the intermediaries marketing channel and 95 farmers in direct selling (predicted values were converted into dummies based on the rule: 0 for values below 0.5 and 1 for values equal to or above 0.5).

The second group of dependent variables are farmer and farm characteristic. The definitions of the data on socioeconomic aspects (age, experience, level of education and household size) and farm characteristics (type of farm, herd size, total labour, land size, finance from the government and off-farm employment) are given in Table 1.

< Table 1 >

6 Results and Discussion

We run the multivariate probit regression analysis using Stata 12. As presented in Table 2, the Wald χ^2 is statistically significant at the 5% level, which indicates that the subset of coefficients of the model are jointly significant and that the explanatory power of the factors included in the model is satisfactory. We also run the multivariate probit regression analysis excluding the socio-economic variables. The results show that the coefficient and sign of the significant variables do not change. Therefore we choose to include them because we assume those variables will give more information on marketing channels choice. The variance influence factors (VIF) were estimated to check the degree of multicollinearity. The results show there are no serious multicollinearity presences among independent variables in the model (VIF's are below 0.464).

The likelihood ratio test of the null hypothesis of independency among the market channel choice ($\rho_{21} = \rho_{31} = \rho_{32} = 0$) is significant at 5%. Therefore, we reject the null hypothesis which implies that there is dependency among the market channel choices. Separately considered, the ρ values indicate the degree of correlation between each pair of dependent variables. The ρ_{21} (correlation between the choice for direct selling and PPIT) and ρ_{31} (correlation between the choice for intermediaries and PPIT) are both negative and statistically significant at the 1% level. This finding indicates that farmers who sell to the PPIT are less likely to sell to direct selling and intermediaries. The ρ_{32} is positive and statistically significant, indicating that farmers who choose direct selling are likely to choose the intermediaries marketing channel as well. These results suggest that farmers who choose

PPIT, prefer to sell all of their milk to PPIT, while farmers who prefer direct selling will also consider selling their milk to the intermediaries marketing channel.

Regarding information costs, the coefficient of price fluctuation is negative and significant for the intermediaries marketing channel. The results indicate that price fluctuation decreases the probability of choosing the intermediaries marketing channel. This implies that having price fluctuation in the intermediaries channel discourages farmers to select this channel. The farmers prefer the marketing channel that offers more stable prices.

With regard to negotiation costs, the sign for delay of payment is negative and statistically significant for the direct selling marketing channel. This result implies that delay of payment decreases the probability of a farmer choosing the direct selling marketing channel. Usually, direct selling offers immediate payment to the farmers. Once the milk is sold, the farmers will receive the payment right after the transaction. However, if a delay of payment occurs in the transaction, farmers are less likely to choose direct selling. Price expectation positively influences the likelihood of choosing PPIT and the intermediaries marketing channel. Unlike direct selling, farmers should have a formal contract if they deal with PPIT or the intermediaries marketing channel.

Concerning to monitoring costs, the coefficient of farm service is positive and significant for direct selling and selling through intermediaries. This result indicates that providing farm service increases the probability of choosing direct selling and the intermediaries marketing channel. The coefficient of trust in buyer is negative and significant for the direct selling marketing channel. This finding indicates that trust in a buyer decreases the likelihood of choosing the direct selling marketing channel. Due to the reason that there is no formal contract involved in the transaction between buyer and seller, the farmers would not really put their trust in the buyer when directly selling. They would expect that sometime the buyer will break the informal contract. James and Sykuta (2006) found that farmers marketing soybeans place higher trust in producer-owned-firms than investor-owned-firms and that trust is correlated with the decision to market soybeans to a producer-owned-firm.

Our results suggest that farmer's socioeconomic and farm characteristics also play an important role in marketing channel choice. The coefficient of age is negative and significant for PPIT. This result indicates that older farmers have a lower likelihood of choosing PPIT. A potential explanation is that older farmers may have vetted networks that contain regular buyers open to direct selling. Therefore, they are not likely to choose PPIT. Consistent with the finding of Matungul et al. (2001), older household heads tend to have more personal contacts, allowing them to discover a trading opportunities at low cost. While younger farmers who are new in this industry are more likely to choose PPIT since PPIT will help the farmers who just started the business. For instance, PPIT offers veterinary advice or marketing strategies to the young farmers.

The coefficient of farmer's experience is positive and significant for the PPIT. This finding indicates that experience increases the likelihood of choosing PPIT. A plausible explanation is that PPIT was established in order to help the farmers in many ways, especially on how to market the milk. Therefore experienced farmers who have experience dealing with PPIT are more comfortable to have transactions with them. Experienced farmer would become reluctant to adopt new market channels with different market requirements. This finding is in line Shiimi et al. (2012) who conclude that as cattle producers in North-Central Namibia engage in the marketing of cattle for long periods of time, they are more likely to sell through a formal market.

The coefficient of education (secondary school) is significant ($\alpha = 0.10$) and negative for PPIT. This result implies that having education up to secondary school decreases the probability of farmer to choose PPIT marketing channel. Farmers who attended the secondary

school are more likely to choose marketing channel that offer higher price which is direct selling or intermediaries. The reason behind this outcome is the farmers are able to understand the requirement set by these channel and they also are able to gather the latest market information. Rather than selling to PPIT and receive a low price, they are more capable to deal with more challenging channels.

The coefficient of education for college or university is positive and significant for the intermediaries marketing channel. This finding suggests that having an education up to college or university increases the likelihood of choosing the intermediaries marketing channel. Farmers who have a higher education, are able to look for a good opportunity in the market place that offers higher prices. They also have ability to fulfil the requirement set by intermediaries marketing channel. This result is in line with the finding of Maina et al. (2015). They found that mango farmers in Kenya who have enjoyed more education are more likely to choose marketing groups rather than local traders.

The negative coefficient of household size for direct selling marketing channel is in line with our theoretical expectation. This result indicates that having a larger household size decreases the probability of farmers choosing the direct selling marketing channel. Farmers are more likely to choose the marketing channel that can secure their income. While in the direct selling marketing channel, farmers cannot guarantee that all their product can be sold. (Monson et al., 2008) found that farmers in Virginia with larger households tend to sell a smaller percentage of their output through direct channels.

The coefficient of finance from the government is negative and significant for the intermediaries marketing channel. This finding suggests that obtaining finance from the government decreases the likelihood of choosing the intermediaries marketing channel. Farmers who get any support from the government tend to send their product to PPIT instead of direct selling and intermediaries. This may be due to the fact that farmers who receive an incentive from the buyer, are more likely to be loyal to their buyer. This result is in line with an earlier study by Woldie and Nuppenau (2009), who found that access to credit has a negative and significant impact on the proportion of output sold through traders.

The results show a significant and positive coefficient of off-farm employment on the choice of the PPIT marketing channel. This result indicates that off-farm employment increases the probability of choosing PPIT. In line with our theoretical expectation, this result suggests that as farmers have off-farm employment, they will have less time to manage their farming activities and also to look for other buyers willing to sell directly to. Therefore, they are more likely to send their product to PPIT, where any amount of milk is accepted.

< Table 2 >

7 Conclusion

This study examined the influence of transaction costs and farmers' and farm characteristics on the selection of marketing channel by Malaysia dairy farmers. Most farmers in our sample decided to sell their milk through the government-run Dairy Industry Service Centres (PPIT). Directly selling to private traders is the second most common channel used. A minority of farmers used intermediaries as their marketing channel choice, including restaurants, hotels or processing firms. Our multivariate probit regression result supports the hypothesis that transaction cost variables influence the selection of milk marketing channels. The variable of price expectation increases the likelihood of using PPIT, whereas delay in payment and trust in buyer decrease the likelihood of using direct selling; The results also showed that price fluctuation decreases the likelihood of using intermediaries, while price expectation and farm service increase the likelihood of using intermediaries. The results also reveal that farmers with diverse socioeconomic backgrounds and farms with different

characteristics differ markedly in their milk marketing channel choice. Age, experience, education (secondary school) and off-farm employment are the variables that have a significant effect for choosing the PPIT marketing channel. While the variable household size are significantly related with choosing the direct selling marketing channel. Education (college/university) and finance from government are significantly related with choosing intermediaries marketing channel. We observe negative correlations between the tendency to choose PPIT and direct selling and also negative correlations between choosing PPIT and intermediaries as marketing channels, while there are positive correlations between direct selling and intermediaries. This indicates that farmers who choose PPIT are less likely to choose direct selling and intermediaries, while farmers who sell their milk to direct selling, sell their milk to intermediaries marketing channel as well. This result supports the hypothesis that farmers make their marketing channel choice decision simultaneously.

These results present important implications for dairy marketing policy in Malaysia. Knowing the source of transaction costs might be useful for any agent that wants to improve the coordination of milk marketing in Malaysia. Government agencies or extension services can create a program of formal contract awareness. This will help reduce the delay in payments and also build trust among buyer and seller. Efforts could focus on enhancing the use technologies such as SMS service and internet to provide access to price information. Providing technical assistance and support such as credit support or providing chillers for free to farmers that used direct selling and intermediaries marketing channel could also be encouraged, in order to stimulate more farmers to engage in these two marketing channels. Dairy farmers who did not have a chance to go to school could be encouraged to attend training or courses on veterinary or management, as our results indicate that schooling can improve their ability to understand and fulfil requirements set by certain marketing channels. Policy makers could also consider establishing dairy cooperatives in Malaysia as some studies (Abdulai and Birachi, 2009, Staal et al., 1997) suggest that collective action such as those pursued by cooperatives can reduce the bureaucratic hurdles in order to reduce transaction costs.

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9 Tables

Table 1: Description and summary statistics of variables

Variables name	Description	Mean	S.D.
y_1	1 if farmer uses PPIT marketing channel	0.86	0.35
y_2	1 if farmer uses direct selling marketing channel	0.53	0.50
y_3	1 if farmer uses intermediate marketing channel	0.22	0.42
<i>Information costs</i>			
Price information	The price of milk is well informed	0.94	0.25
Price fluctuation	The price of milk does fluctuate much	0.57	0.50
<i>Negotiation costs</i>			
Payment delay	Farmer does not receive his payment on time	0.69	0.46
Price expectation	Farmer receives a price close to his expectation	0.23	0.42
<i>Monitoring costs</i>			
Trust in buyer	Farmer trusts his buyer's business skills	0.82	0.39
Farm services	Farmer receives technical support from buyer	0.15	0.35
<i>Farmer and farm's characteristic</i>			
Age	Age of farmer in 2015	44.24	11.20
Experience	Number of years in farming activity	17.71	10.58
Secondary school	1 if farmer went to secondary school, 0 otherwise	0.65	0.48
College or university	1 if farmer went to college or university, 0 otherwise	0.08	0.27
Household size	Number of family members	5.86	2.23
Type of farm	Type of farm (0 = semi-intensive, 1 = intensive)	0.5	0.50
Herd size	Number of cattle in the farm in 2015	31.53	19.26
Total labor	Number of people who work in the farm	3.09	1.51
Land size	Size of land for farming activities (in hectares)	70.74	137.21
Finance from government	Whether farmer received any finance from the government or not (0 = No, 1 = Yes)	0.44	0.50
Off-farm employment	Whether farmer has another job (0 = No, 1 = Yes)	0.27	0.44

Table 2: Multivariate probit model results explaining Malaysian farmers' marketing channel selection

Variables	Type of marketing channel		
	Sale to PPIT	Sale to direct selling	Sale to intermediaries
Price information	-1.89 (2.53)	-0.58 (0.50)	0.46 (0.63)
Price fluctuation	-0.18 (0.36)	0.01 (0.22)	-0.67** (0.29)
Delay of payment	-5.78 (182.64)	-0.74** (0.30)	0.07 (0.35)
Price expectation	1.39** (0.66)	0.07 (0.25)	0.89** (0.38)
Farm service	5.15 (275.74)	1.27*** (0.31)	0.57* (0.34)
Trust in buyer	-0.66 (2.27)	-0.49* (0.28)	0.05 (0.41)
Age	-0.07*** (0.02)	-0.00 (0.01)	0.02 (0.01)
Experience	0.05** (0.02)	0.01 (0.01)	0.01 (0.01)
Edu: Secondary	-0.66* (0.37)	-0.20 (0.25)	0.12 (0.27)
College/ University	4.56 (357.51)	0.27 (0.45)	1.17** (0.51)
Household size	0.02 (0.08)	-0.08* (0.05)	0.09 (0.07)
Intensive farm	0.32 (0.37)	0.11 (0.24)	0.01 (0.33)
Herd size	0.00 (0.01)	0.00 (0.00)	0.00 (0.01)
Labor	-0.04 (0.13)	0.06 (0.07)	0.10 (0.09)
Farm size	0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)
Finance from government	-0.01 (0.36)	-0.20 (0.22)	-0.63** (0.31)
Off-farm employment	0.70* (0.41)	-0.34 (0.21)	-0.08 (0.25)
Constant	10.93 (182.68)	1.82* (0.94)	-3.66*** (1.29)
ρ_{21}		-0.72***	
ρ_{31}		-0.43***	
ρ_{32}		0.35**	
Number of observations		200	
Wald chi ²		70.32	
Probability		0.04	
Log Likelihood		-249.21	
Likelihood ratio test $H_0: \rho_{21} = \rho_{31} = \rho_{32} = 0$; $\chi^2(3) = 21.22$ ***			

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$