# Network resilience and risk attitudes: Evidence from Vietnamese Vegetable Farming

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**Abstract**

We explore the relationship between risk aversion, loss aversion, and procrastination and the resilience of trading networks in small scale rural farming in Vietnam. Rural farmers are highly dependent on intermediary traders to bring products to market. We survey farming households in three villages to obtain data on the trading network. We find that each village has a very distinctive trading network but none of them are resilient, with the typical farmer relying on one or two traders with whom they have traded for many years. In one village, with the most resilient network, we find evidence that risk aversion and loss aversion is associated with a household engaging with, respectively, more and less traders. In a separate village, the one with the fewest number of traders, we find a positive relationship between procrastination and the number of trading links.

**Keywords**: Network resilience; Risk preferences; Risk aversion; Procrastination; Trading network; Intermediary traders; Vegetable farming.

**JEL codes: D13, D85, D90, O13, Q12, Q13**

# 1 Introduction

Small scale rural farming is fundamentally important in developing countries and to global food supply chains (McCullough, Pingali and Stamoulis, 2012; Lowder, Skoet and Raney, 2016). Small farms contribute to agricultural production, food security, rural poverty reduction and biodiversity conservation, while remaining the main form of employment and livelihood across Africa and Asia (Thapa and Gaiha, 2011). The policy landscape concerning small farms is inevitably multi-faceted ranging from issues around poverty alleviation in developing countries to food security in developed countries, and from uptake of technology innovation to the distribution of financial gain across the supply chain (Hazell et al., 2010; Lipton, 2010). This policy landscape is further complicated by climate change, which is posing a fundamental challenge to traditional methods and models of farming in developing countries (Morton, 2007; Karki, Burton and Mackey, 2020). In understanding and evaluating small scale farming it is crucial to consider the trading network into which farmers sell their products. In particular, a small scale farming household will typically sell their products to an intermediary trader (at a village level) who can then transport the product to urban areas and further resale and trading. The relationship between farmer and trader is crucial in determining the income of the household, as well as crop choice, technological uptake and innovation (Schoonhoven-Speijer, Mangnus and Vellema, 2017; Xhoxhi, Pedersen and Lind, 2018).

A vital goal for policy, particularly with evolving threats such as climate change, should be resilient trading networks. Trading networks that are able to maintain both supplies of food for market and income for rural households despite negative shocks. Network resilience largely depends on the structure and characteristics of the trading network (see, e.g. Fair, Bauch and Anand, 2017; Rockenbauch and Sakdapolrak, 2017; Dolfing, Leuven and Dermody, 2019). Unfortunately, as we will discuss shortly, relatively little work has been undertaken that maps trading networks in small scale farming communities and explores the behavioural factors that influence link formation in those networks. In this paper we report on a study designed to analyse the trading network of small scale vegetable farmers in three villages in Vietnam. Our study had three main objectives. First, to map the trading network and, in particular, investigate how many traders a typical household interacts with

on an annual and longer term basis, as well as how many households a typical trader interacts with. Second, to explore the behavioural factors that may influence a farmers trading choices, with a particular focus on risk preferences and time preferences. Third, given our enhanced understanding of the trading network, to consider possible policy interventions that can enhance the resilience of the trading network to shocks, for the benefit of both farmers and food security.

In our study we surveyed farmers at three distinct villages in northern Vietnam ($n > 400$). The survey elicited the households trading strategy and trading links, as well as measures of risk aversion, loss aversion and procrastination. This information was sufficient to characterise the trading network. Interestingly, we find significant differences in network structure across the three villages. At one site (Pham Tran) the trading network is dominated by only 3 traders, while at the other two sites trading is more dispersed. Of these two sites, one (Van Hoi) has many more trading links than the other (Van Duc). One key finding of our study, therefore, is considerable heterogeneity in trading networks, even across three similar villages within a relatively narrowly defined geographical area. Moreover, at all three sites the network can be characterised as non-resilient with the typical household reliant on only one or two traders to bring their product to market. These findings clearly the demonstrate the need for a better understanding of trading networks in small scale farming and the behavioural factors that influence link formation. In our study we explore the role of risk aversion, loss aversion and procrastination, and find a significant relationship between all three and link formation. Specifically, in Van Hoi, the site with most links, we find evidence that risk averse and loss averse households are associated with, respectively, more and less trading links. Also in Pham Tran, the site dominated by few traders, we found that procrastination is associated with more trading links.

We proceed as follows. In Section 2 we provide a background discussion of trading networks in small scale farming and the potential role of behavioural factors. In Section 3 we describe the methods used in our study of vegetable farmers in Vietnam. In Section **??** we provide our study results. We conclude in Section 5.

## 2 Networks and Behaviours

Small scale farmers are typically highly reliant on intermediary traders to bring their product to market. They may also be reliant on local traders for diffusion of information on prices, what crops to grow, when to harvest etc. (Maertens and Barrett, 2013; Ramirez et al., 2018). The relationship between small scale farmers and intermediary traders is, therefore, critical for both the supply of food and the livelihoods of farming households. Particularly important for food supply and security is the resilience of the trading network to shocks. A key measure of network resilience is the performance of a network if 'random failures' remove nodes or edges. We depict this in a stylized way in Figure 1. The top half of the figure shows a network with 7 farmers and 3 traders, where edges indicate a trading relationship between farmer and trader. In the bottom half of the figure we depict the network in the scenario where trader B, for some reason, is unable to trade. You can see that the removal of trader B has a profound impact on the network with two farmers losing their only route to market. In a non-durable goods market with perishable and seasonal produce this could have a profound impact, particularly as small scale farmers typically have no insurance.

The network depicted in Figure 1 is not resilient. If a trading network is not resilient than farmers are exposed to considerable risk because any shocks to the network could leave them highly exposed. It is desirable, therefore, that networks be resilient. This is especially important in the face of global challenges, particularly climate change, that could lead to significant shocks in trading networks. A large literature, within network science, has looked at factors that increase resilience in general networks (e.g. Basole and Bellamy, 2014; Kim, Chen and Linderman, 2015; Li et al., 2020). Three key insights from this literature are that network resilience is higher the shorter the average path length between nodes (Nair and Vidal, 2011), the larger the number of nodes (Sadghiani, Torabi and Sahebjamnia, 2015), and the higher the node capacity (Li and Zobel, 2020). Applying those insights to small scale farming suggests that resilience is increased by having more traders and more links between farmers and traders. The intuition being relatively straightforward in that more traders and more links means a farmer is less exposed to the breakdown of a particular trading link.

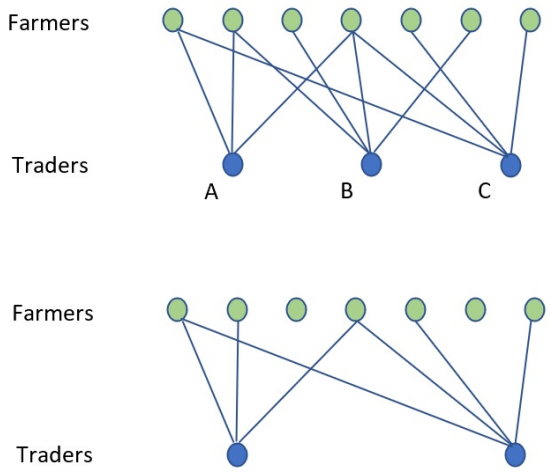


**Figure 1**. A snapshot of a supply network with small scale farmers reliant on traders to bring products to market. Resilience can be measured by the effect of removing nodes.

Having recognised the importance of the structure and resilience of the trading network for small scale farming we identify three fundamental research questions: (a) What structure do trading networks have in small scale farming and is this structure resilient? (b) What behavioural factors on the part of farmers and traders influence the structure and characteristics of the trading network? (c) Are there policy and behavioural interventions that could improve the resilience of the trading network? We would argue that the literature addressing these questions is still in its infancy. While there is a vast literature mapping social, trading and financial networks in developed countries, there are challenges to mapping networks in rural areas of less developed countries (see Chuang and Schechter (2015) for a review of the literature). Evidence is, thus, limited to a small number of studies.

The evidence that exists points towards a lack of resilience. For example, studies have looked at the spread of disease in poultry markets in countries such as Mali (Molia et al., 2016), Bangladesh (Moyen et al., 2018), Madagascar (Rasamoelina-Andriamanivo et al., 2014), Vietnam (Soares Magalhães et al., 2010), Ethiopia (Vallée et al., 2013) and Cambodia (Van Kerkhove et al., 2009). They show that poultry trading networks appear to have the features of scale-free networks and are unlikely to be resilient against the removal of a few central nodes (Molia et al., 2016; Moyen et al., 2018; Rasamoelina-Andriamanivo et al., 2014). Similar results are obtained by González-Mon et al. (2019) when analysing the structure of fish trading relationships in Mexico. Specifically, they find that a few buyers with more connections maintain a central position indicative of a scale-free network. Buyers

in the edge positions have the lowest level of adaptive capacities as they are limited to just a few options for trade. Such evidence reinforces the need to address questions (b) and (c), above, with a focus on improving network resilience for small scale farmers.

A particular focus of our work is on the behavioural factors that influence network structure. If, for instance, we map the network and find (as prior studies suggest) that the trading network would be more resilient were small scale farmers to engage with more traders, then why are they not doing that? There is an established literature on endogenous networks and strategic link formation (e.g Jackson and Wolinsky, 1996) that we can draw on to address this question. There is also a growing body of literature that explores farmers' behaviours and factors that influence intention to adopt new practices, and insurance products that could impact on their income and resilience against shocks. A recent review by Dessart, Barreiro-Hurlé and van Bavel (2019) classifies behavioral factors into three main groups: (i) dispositional factors, (ii) social factors and (iii) cognitive factors. In our work we focus on risk risk attitudes (Kovářík and Van der Leij, 2014) and procrastination (Duflo, Kremer and Robinson, 2011). These can be classified as dispositional factors (e.g. risk tolerance) and to some extent the cognitive factors (e.g. perceived risks).

In our view, risk attitudes are likely to be a prevalent factor impacting on trading decisions in developing countries. Farmers and smallholders are found to be risk-averse in rural areas across Africa (Brick and Visser, 2015; Fischer and Wollni, 2018; Magnan et al., 2020), China (He et al., 2020; Jianjun et al., 2015; Liu, 2013), and Vietnam (Khor et al., 2018; Nielsen, Keil and Zeller, 2013; Van Song et al., 2020*a*). Furthermore, farmers with a high degree of risk aversion are less likely to adopt new farming methods and more sustainable practices (Brick and Visser, 2015; Gao et al., 2020; Jianjun et al., 2015; Liu, 2013; Magnan et al., 2020; Van Song et al., 2020*b*). For example, farmers in Vietnam with a higher degree of risk aversion are found to use less fertiliser to combat declining soil fertility (Khor et al., 2018). Exposure to a natural disaster, such as flood, has also been shown to increase risk aversion (Reynaud and Aubert, 2020).

To create a new trading link is a form of innovation. Risk aversion may, therefore, influence trading strategy, and willingness to connect with new traders. For example, Abebe et al. (2013) argue that because of risk-aversion, Ethiopian farmers prefer to trade with private buyers if they could provide inputs and technical assistance rather than government

agencies or NGOs. Similarly, Mgale and Yunxian (2020) show that the higher a Tanzanian farmers' risk perception, the higher the probability of selling their products to village-level collectors, rather than more profitable markets. Based on our reading of the prior literature, we propose two hypotheses. Our first hypothesis is that risk averse farmers will be inert in changing trading relationships because of reluctance to adopt new practices.

**Hypothesis 1** *Farmers with higher levels of risk aversion are less likely to switch traders over time. They will, thus, be reliant on long standing trading relationships.*

In terms of the trading network, Hypothesis 1 suggests that links will be more stable over time for risk averse farmers. This could lower resilience because the network will be less able to evolve in the face of shocks that, for instance, remove a trader from the network.

Our second hypothesis is that risk averse farmers will be more inclined to diversify their trading, and, in particular, to avoid relying on only one trader. In particular, farmers risk attitude has been found to be an important factor that motivates farmers' engagement in off-farm income activities. In a study by Ullah and Shivakoti (2014), they found a positive relationship between farmers' risk aversion and their adoption of both on- and off-farm activities. The finding is echoed by later studies (Akhtar et al., 2019; Iqbal et al., 2016; Krause, 2019). The adoption of on-farm techniques as well as off-farm income activities, a risk management strategy of farmers, is positively associated with inputs and outputs, such as the value of crop grown (Fernandez-Cornejo, Beach and Huang, 1994) and the number of livestock in the farm (Akhtar et al., 2019).

**Hypothesis 2** *Farmers with higher levels of risk aversion will be less likely to trade with only one trader (at any one point in time).*

Hypothesis 2 means that there could be more links associated with risk averse farmers, as they look to diversify trading risk. This should relatively increase resilience of the network. Hypotheses 1 and 2, while they are not inconsistent, point to potentially complex and competing influences of risk aversion on network resilience. In particular, risk aversion could plausibly increase or decrease resilience. Hence a need for empirical studies that allow us to explore the relationship between risk aversion and trading strategy in the field. Alongside risk attitudes we considered it important to consider other potential factors, including loss

aversion and procrastination.

Few studies have looked at loss aversion and farming behavior, but some recent works point to its potential influence. In particular, both Jin et al. (2020) and He et al. (2019) find that loss aversion is positively associated with willingness of farmers in China to adopt new practices. Similarly, Visser, Jumare and Brick (2020) find that loss averse farmers in South Africa are more likely to adopt technology bundled with insurance. An intuition for these results is that loss averse farmers actively look to adopt practices that will avoid future losses, and are thus more open to innovation.

**Hypothesis 3** *Farmers with higher levels of loss aversion will be less likely to trade with only one trader (at any one point in time).*

A household that procrastinates will delay, potentially indefinitely, changes to farming and trading practice. For instance, Duflo, Kremer and Robinson (2011) model how present bias and procrastination can lead to farmers delaying indefinitely the use of fertilizer. We hypothesize, therefore, that procrastination may also negatively impact innovation in trading relationships.

**Hypothesis 4** *Farmers who procrastinate are less likely to form new trading links.*

While our focus will be on risk aversion, loss aversion and procrastination we briefly highlight other psychological factors of interest. Trust has been widely shown as a determinant of farmers' trading strategies. For example, Maloku et al. (2021) find that trust in traders significantly influences farmers' interest to increase agricultural activity in Albania. Fischer and Wollni (2018) find that farmers in Ghana with low levels of trust would opt for immediate payment, agreement on purchase before cultivation, and require transparency of product classification processes. Moreover, Herforth et al. (2015), Mgale and Yunxian (2020), Schipmann and Qaim (2011) suggest trust influences farmers trading choices in Ecuador, Tanzania and Thailand, respectively. In Vietnam, Hung Anh and Bokelmann (2019) find that trust is one of the main factors explaining repeated transactions between coffee farmers and local traders. Recently, Van Nguyen, Schwabe and Hassler (2021) also shed light on mutual trust as an explanatory factor for the interrelationship between input suppliers, farmers and middlemen.

Additionally, farmers' social ties significantly impact on their economic activity (Conley and Udry, 2010; Johny, Wichmann and Swallow, 2017; Van den Broeck and Dercon, 2011). Smallholders are often locked in trading relationships because of their strong ethnic and religious ties, or credit constraints and history of transactions. See, for example, evidence from Ethiopia (Abebe, Bijman and Royer, 2016; Ali and Peerlings, 2011), Indonesia (Kopp and Salecker, 2020) and India (Negi et al., 2018). In a study about the relationship between Kenyan rose exporters and their foreign buyers, Macchiavello and Morjaria (2015) find that producers continue to trade with buyers during an exogenous shock, to protect their reputation. In Vietnam, similarly, because of the social and credit-bound relationship, a high proportion of farmers sell to traders and buying agents that consequently lead to repeated transactions and strengthen their trust (Hung Anh and Bokelmann, 2019; Zimmer et al., 2018). Also, Linh et al. (2019), and Nielsen, Keil and Zeller (2013) have uncovered that Vietnamese farmers' informal credits overwhelmingly rely on relatives, friends, neighbours and local private lenders within the village or district. Finally, when they have to adopt new models such as new technology which often bring more uncertainty to their business, they often rely on their network. Recent evidence shows that Italian farmers are more likely to adopt new technology if they receive positive feedback from their fellow farmers (Blasch et al., 2022).

Risk, loss aversion and procrastination should, thus, be viewed in a context where trust and social ties have been shown to be important. Household's characteristics can also influence trading decisions. Abebe, Bijman and Royer (2016), for example, find that older or higher education farmers in Ethiopia prefer trading with middlemen rather than selling to wholesalers. This result echoes previous findings that younger farmers in Greece are less likely to be embedded in social networks and show lower levels of trust in institutions such as agricultural cooperatives (Koutsou, Partalidou and Ragkos, 2014). In an early study by Fafchamps and Hill (2005), households' wealth is found to associate with their choices to sell to market or traders at farm-gate. Similarly, Negi et al. (2018) show that smaller farmers are more likely to depend on local traders due to high transportation costs. In our survey we look to control for education and wealth.

# 3 Survey Methods

We collected data on farm characteristics, trading networks and risk and time preferences from over 400 vegetable farmers split across three villages in Vietnam. The three sites are: Van Hoi (Tam Duong district, Vinh Phuc province), Van Duc (Gia Lam district, Hanoi) and Pham Tran (Gia Loc district, Hai Duong province). Van Hoi and Van Duc belong to the peri-urban area of Vinh Phuc and Hanoi city. Meanwhile, Pham Tran is further from urban areas (see Figure 1 in the Supplementary Material). Vegetable production has been present for over 30 years in these villages. Table 1 summarises some main characteristics of the sites. As you can see, we survey more than 10% of total households at each site. This allows us to accurately estimate the overall trading network.

**Table 1**. Characteristics of survey sites

| Site | Van Hoi | Van Duc | Pham Tran |
|---|---|---|---|
| Time to Hanoi | 90mins | 30mins | 90mins |
| Vegetable area | 300ha | 200ha | 29ha |
| Vegetable production households | 800 | 1500 | 300 |
| Number of traders | 42 | 63 | 8 |
| Vegetable varieties | Diversified | Diversified | Cabbage |
| Households surveyed | 176 | 180 | 123 |

The survey covered the following broad set of questions:

- General information about households members, including gender, education, age and job.
- Vegetable production, including share of household income, employment of labor, and land area and yield per type of vegetable.
- Who in the household makes selling decisions, and the selling strategy used for each type of vegetable, comparing traders, cooperatives and local markets.
- The characteristics of buyers the household engaged with, including name, products, frequency of interaction and duration of contact. This directly allows us to map the trading network at the survey site.
- General risk aversion was measured with the question 'In comparison to others, are you a person who is generally willing to take risks?' with answers on a 5 point Likert

scale from strongly disagree to strongly agree. This question is relatively easy to ask in the field and has been shown to have good validity (Dohmen et al., 2011).[1] We also measured uncertainty with respect to their business with the question 'If possible, I would avoid all uncertainty in my business'. This was again measured on a 5 point Likert scale.

- We measured loss aversion with two questions 'In comparison to others, if my business suffers a loss, I am willing to invest more to regain the loss'. And 'When facing a financial decision, I am more concerned about the possible losses than the possible gains'. Both were measured on a 5 point Likert scale.

- Time preference was measured with the question 'In comparison to others are you a person who is generally willing to give up something today to benefit from that in the future?' We also adapted two questions from the Irrational Procrastination Scale (Steel, 2010). These are 'If there is something I should do, I get to it before attending to anything else' and 'When I should be doing one thing, I will do another'.[2] These questions were again measured on a 5 point Likert scale.

At each of the three sites we obtained a list of households producing vegetables in the study areas.[3] We then used the random sampling technique to select a subset of target households from the lists. With the support of the relevant local authorities and cooperatives, those selected were invited to attend a communal hall to complete the survey. This approach worked well in Van Duc and Pham Tran with all invited households attending. In Van Hoi, again with the support of the local authorities, the team had to change approach, because of low attendance, and survey households at their fields. Our final sample contains 180 complete household surveys in Van Duc, 176 in Van Hoi and 123 in Pham Tran. In Table 2 we provide a summary of respondent and household characteristics for each survey site. Overall, you can see that the characteristics are similar across the three villages. One

[1] Alternative, more complex, methods can also lead to inconsistencies that are correlated with under-education (Brunette and Ngouhouo-Poufoun, 2022).

[2] These had to be adapted for the field depending on situational circumstances. For instance, asking: You planned to spray pesticides on vegetables today, but your neighbour asks you to drink. There is no one else to do the task. How will you handle it? a) Decline the invitation of a neighbour and keep going to work in the fields b) Depending on your mood, you can choose to work or drink. c) Leave the farm work until the next day and accept the invitation of the neighbours to lesser tasks.

[3] In Van Hoi, we found this list from both the Green Van Hoi Cooperative and the village authority. In Van Duc, we accessed the list of households producing vegetables from Van Duc Safe Vegetable Cooperative. At Pham Tran, the list was provided by the village authority.

**Table 2**. Summary statistics of respondents and households characteristics.

| | **Pham Tran** | **Van Duc** | **Van Hoi** | **All** |
|---|---|---|---|---|
| Head of household (%) | 100.0 | 70.00 | 100.0 | 88.52 |
| Farmer (%) | 95.93 | 94.44 | 97.16 | 95.82 |
| Female (%) | 60.16 | 65.56 | 70.45 | 65.97 |
| Secondary school education (%) | 65.85 | 75.00 | 62.50 | 68.06 |
| Primary school education (%) | 23.58 | 17.78 | 26.14 | 22.34 |
| Age | 56.02 | 55.11 | 53.86 | 54.89 |
| | (11.78) | (9.67) | (9.94) | (10.36) |
| Number of household members | 3.67 | 4.36 | 4.86 | 4.37 |
| | (1.49) | (1.57) | (1.62) | (1.63) |
| Number of labourers | 2.41 | 2.83 | 3.10 | 2.82 |
| | (0.91) | (1.05) | (1.02) | (1.04) |
| Total land used | 7.55 | 7.01 | 7.24 | 7.23 |
| | (9.47) | (4.02) | (4.02) | (5.91) |
| Proportion of income from vegetables (%) | 76.34 | 67.91 | 55.76 | 65.61 |
| | (27.94) | (27.55) | (26.77) | (28.52) |
| Types of vegetable | 1.61 | 3.10 | 3.24 | 2.77 |
| | (0.84) | (0.99) | (1.26) | (1.27) |
| Sold to local market (%) | 2.35 | 8.11 | 15.60 | 9.38 |
| | (13.22) | (24.77) | (25.19) | (23.11) |
| Sold to traders (%) | 97.62 | 88.82 | 75.61 | 86.23 |
| | (13.22) | (25.97) | (30.12) | (26.59) |
| Sold to cooperative (%) | 0.00 | 2.89 | 7.96 | 4.02 |
| | (0.00) | (9.54) | (17.62) | (12.58) |
| Average price of vegetables (by average price, VND) | 6507 | 5106 | 6414 | 5946 |
| | (765) | (2321) | (3117) | (4581) |
| Average price of vegetables (by maximum price, VND) | 8944 | 8701 | 10755 | 9515 |
| | (3831) | (4747) | (4396) | (4490) |
| N | 123 | 180 | 176 | 479 |

noteworthy difference, as previously mentioned, is that households in Pham Tran grow a significantly less diversified crop than in Van Duc and Van Hoi.

# 4 Results

Figure 2 provides an overview of the trading system in the three villages. In the Figure, each village is assigned a number: number 1 is Van Hoi, number 2 is Van Duc and number 3 is Pham Tran. With these codes, we can see how a typical household in each village sells their products. For instance, the code 123 indicates that all three villages sell their products to local based collectors or traders. Only Van Hoi and Van Duc have access to cooperatives (code 12). From intermediary traders the products find their way to provincial/inter-provincial markets and beyond. In Table 2 we see the main selling method of the farmers in all three villages is via traders. Indeed, this accounts for at least three quarters of sales, illustrating the critical importance of intermediary traders to small scale

farming households.

**Result 1** *Sale to intermediary traders is the primary method used by farmers in all three villages in our study, even where local markets and cooperatives exist.*

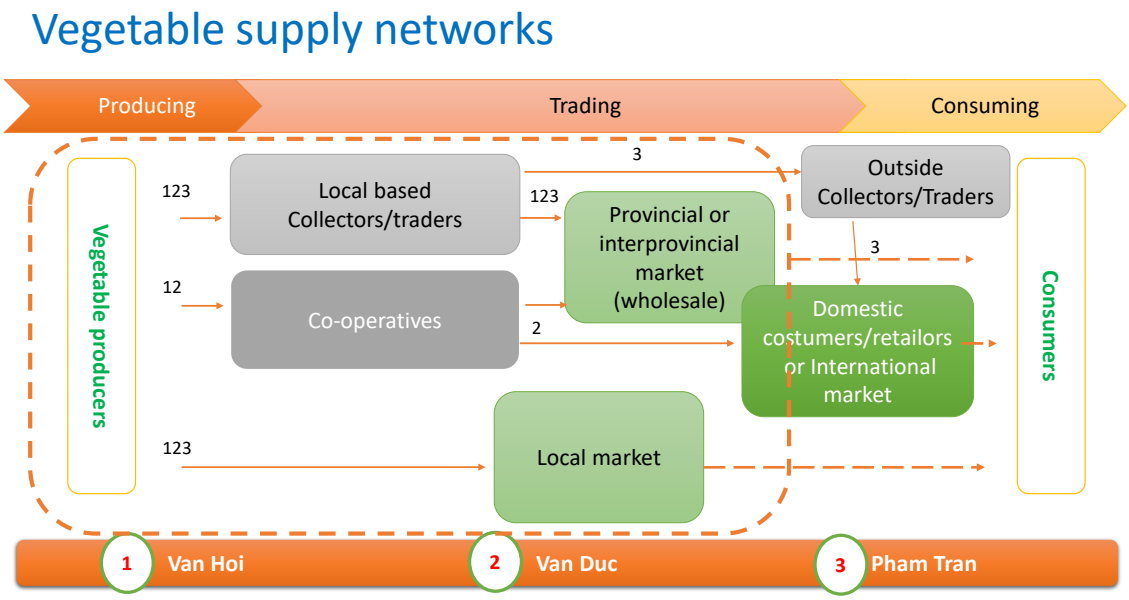


**Figure 2**. The supply network.

## 4.1 Trading network

In Table 3 we report summary statistics on household trading behaviour and in Figure 3 we plot the distribution of the number of traders that a household engages with in each village. Interesting differences can be observed across the three sites. In Van Duc, over half of those surveyed were working with only one trader and over three quarters of households were reliant on only one marketing channel (trader, cooperative or local market).[4] By contrast, in Van Hoi, the average household is interacting with two traders and has multiple routes to market.

While Pham Tran may seem to be an intermediary case in terms of the trading network, we remind (see Table 1) that Pham Tran has significantly fewer traders, proportionally, than Van Duc and Van Hoi. To illustrate the implications of this difference, in Figure 4 we plot the distribution of the number of households (in our survey) that trade with each identified

[4]This is similar to a study by Herforth et al. (2015) on blackberry farmers in Ecuador that finds that the vast majority (87%) of farmers do not sell to more than 1 channel.

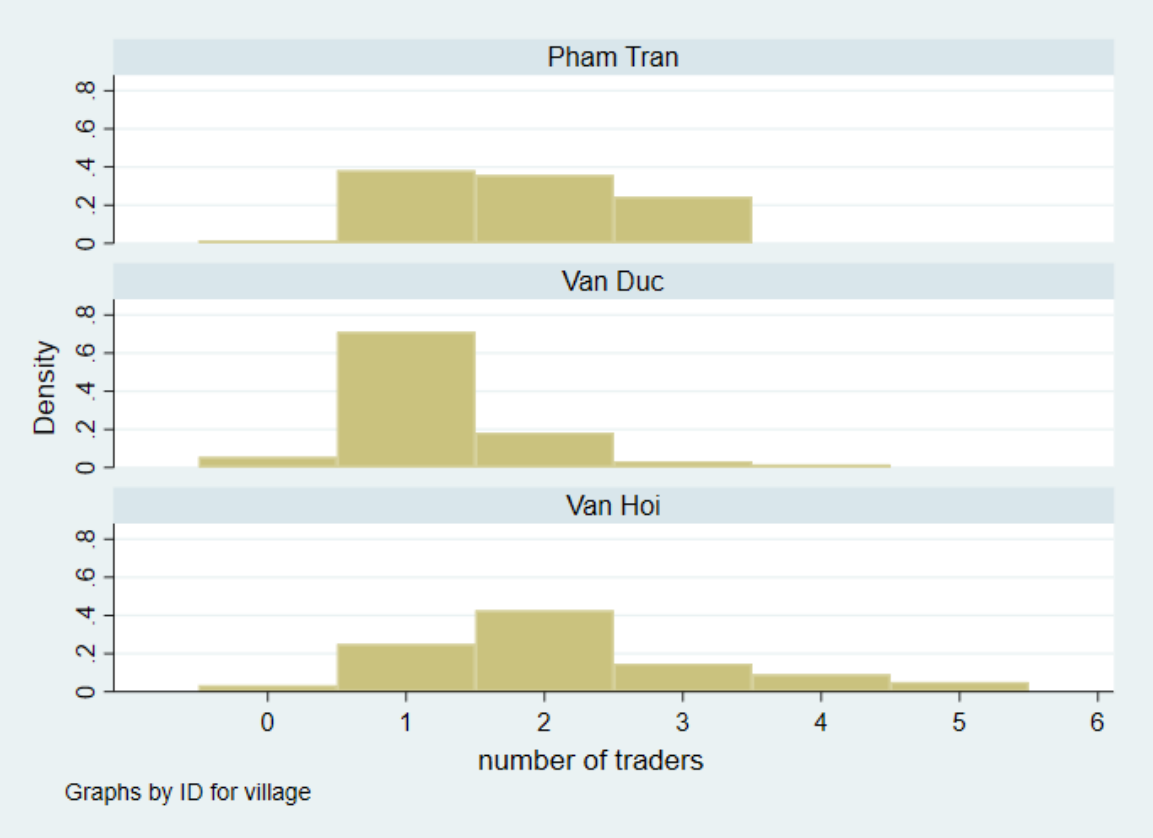


**Figure 3**. The distribution of the number of traders a household trades with by each village.

trader. You can see that in Van Duc and Van Hoi the typical trader is interacting with less than twenty households. Indeed, Van Duc does not have any traders trading with more than 20 households.[5] In Pham Tran, by contrast, there are 8 traders of which we can see that 3 engage with over 50 households. The network is, thus, dominated by these three traders.

Figure 5 illustrates the sub-network between households and traders. We find that each of the three villages have a specific network structure. In Van Duc there are relatively few links with most farmers interacting with only one trader. There are also relatively many traders. In Van Hoi there are more links, with most farmers interacting with two or more traders. Given the larger number of links we can say that the trading network in Van Hoi appears more resilient than that in Van Duc. Pham Tran is characterised by a fewer number of traders. Again, the larger number of links suggests the trading network in Van Hoi is more resilient than that in Pham Tran. Given that Pham Tran has more links but fewer

[5]In Table 2, the average percentage of vegetables Van Duc's households sell to the local market and cooperatives is also lower than that of households in Van Hoi. Thus, the low number of connected households of traders in Van Duc should not be due to households' relationships with cooperatives.

**Table 3**. Summary statistics of respondents and households' trading strategy.

| | **Pham Tran** | **Van Duc** | **Van Hoi** | **All** |
|---|---|---|---|---|
| Have only 1 marketing channel (%) | 95.12 | 77.22 | 38.07 | 67.43 |
| Working with 1 trader only (%) | 37.40 | 55.00 | 7.00 | 33.00 |
| Total number of traders | 1.83 | 1.24 | 2.16 | 1.73 |
| | (0.82) | (0.68) | (1.16) | (1.00) |
| Proportion of traders who are relatives | 27.55 | 34.12 | 29.78 | 30.79 |
| | (0.43) | (0.47) | (0.41) | (0.44) |
| Proportion of traders who are neighbours | 47.38 | 36.37 | 49.41 | 44.07 |
| | (0.48) | (0.47) | (0.45) | (0.47) |
| Years of trading with trader (oldest) | 13.26 | 8.91 | 9.14 | 10.14 |
| | (5.93) | (5.32) | (5.82) | (5.99) |
| Years of trading with trader (newest) | 12.62 | 8.24 | 7.6 | 9.15 |
| | (5.96) | (5.53) | (5.66) | (6.05) |
| Visit frequency of oldest trader (%) | 100 | 94.71 | 93.53 | 95.66 |
| Average kg per trader | 72.75 | 79.56 | 57.76 | 69.91 |
| | (21.77) | (20.37) | (22.60) | (23.67) |
| Willing to adopt new marketing channel (%) | 21.14 | 13.89 | 20.45 | 18.16 |
| Willing to adopt competition among traders (%) | 16.26 | 12.78 | 18.18 | 15.66 |
| Willing to cooperate with new trader (%) | 28.46 | 41.11 | 17.05 | 29.02 |
| Sell to market by wife (%) | 33.33 | 42.11 | 74.36 | 67.00 |
| Sell to market by both (%) | 33.33 | 31.58 | 16.67 | 20.00 |
| Sell to traders by wife (%) | 41.32 | 38.6 | 70.76 | 51.19 |
| Sell to traders by both (%) | 52.89 | 40.94 | 16.37 | 34.99 |
| N | 123 | 180 | 176 | 479 |

Notes: Unless stated we report mean (standard deviation).

nodes there is no clear finding on whether Pham Tran or Van Duc would be more resilient.

**Result 2** *We find significant differences in the structure and characteristics of the trading network across the three villages surveyed. The network in Van Hoi is more resilient than in the other two villages.*

Result 2 suggests that caution is needed in extrapolating results from rural farming communities. Here we have three villages that are relatively similar and yet have very distinct trading networks. This distinctiveness may follow from geographical location, and social and historical precedence. For instance, we can see in Table 3 that households are typically trading with the same trader for an average of at least 10 years. Also most traders are either relatives or neighbours. That households choose known traders may derive from their social relationships rather than economic incentives. Selling vegetables, in this case, carries the meaning of maintaining social solidarity and uniting the community through economic cooperation (between households and relatives or neighbours). Consistent with

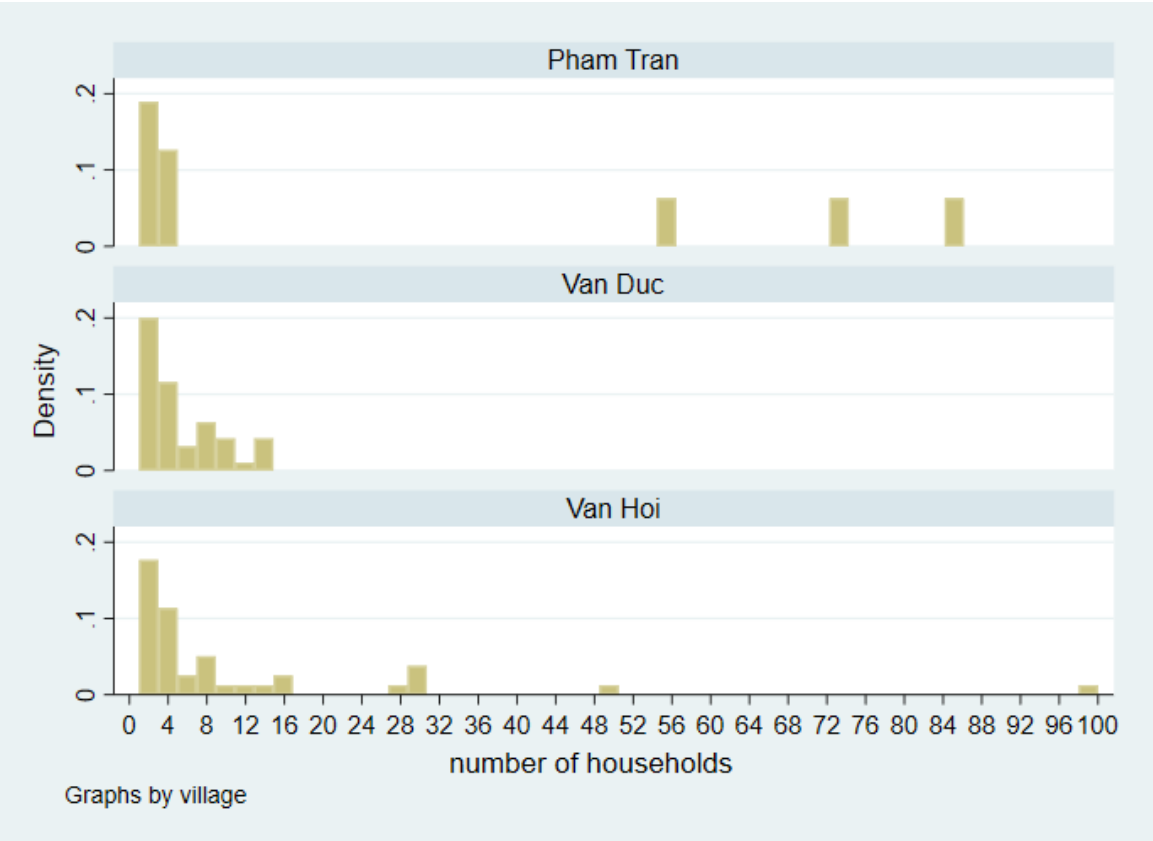


**Figure 4**. The distribution of the number of households a collector trades with by each village.

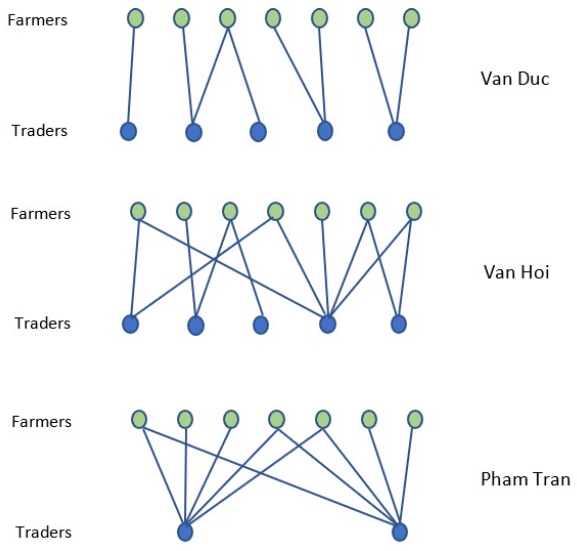


**Figure 5**. A stylized representation of network structure across the three survey sites.

this, the majority of the oldest traders (96%) visit the farm on every harvest.[6] Most long-term traders are also the ones whom households sell the highest proportion of their

[6] Although other traders visit less often, their frequency is still higher than 50%.

vegetables to.

**Result 3** *Households are typically reliant on one marketing channel, and one or two traders with whom they have a personal connection and a long-term, established trading relationship of around 10 years.*

Result 3 is consistent with Hypothesis 1 and indicative of relatively low network resilience at all three sites surveyed (including Van Hoi which we identified as most resilient of the three). This is primarily because of the low number of links and the inertia of links to change. To put some perspective, in a study about the importance of buyer's beliefs about seller's reliability within the Kenyan rose export market, it was estimated that a rose producer has trading relationship with around 3 buyers (Macchiavello and Morjaria, 2015). That compares with an average of 1.7 for the vegetable farmers in our survey. A network with 3 links per node is considerably more resilient that one with 1-2 links per node. We also observe a reluctance of farmers to change their trading strategy. Specifically, in Table 3 you can see that less than 20% of households we surveyed were willing to adopt a new marketing channel, or competition among traders, and less than 30% willing to cooperate with a new trader. Although, we note that in Van Duc, where the number of links is lowest, 41% of households were willing to cooperate with a new trader.

### 4.2 Risk and time preferences

We have seen that all three villages we surveyed had very different trading networks. We also see considerable heterogeneity within villages in terms of the number of traders used (see Figure 3). We now evaluate our hypotheses and consider the extent to which risk and time preferences can explain heterogeneity in trading behavior. To test the role of risk aversion we report the results of a regression analysis using the following empirical specification:

$$nt_{hv} = \beta_0 + \beta_1 \text{risk}_{hv} + \alpha X_{hv} + I_v + u_{hv} \tag{1}$$

where the dependent variable $nt_{hv}$ is the number of traders that a household $h$ in village $v$ trades with. The key independent variable $\text{risk}_{hv}$ is the household response to the question 'In comparison to others, are you a person who is generally willing to take risks?' measured on a 5 point scale. The vector $X_{hv}$ controls for several characteristics of the household,

including family size, age, and education, as well as the gender of the respondent.

Table 4 reports our results. In Column (1) we report results across the three villages, including village fixed effects. The default is Pham Tran. In Columns (2-4) we report results at village level. We see that in Pham Tran and Van Duc there is no evidence of a relationship between risk taking and trading. In Van Hoi, by contrast, we find a significant negative relationship between willingness to take risk and number of traders. In other words, those classified as more risk seeking have a lower number of traders than those classified as risk averse. This finding is consistent with Hypothesis 2. We also see a highly significant positive relationship between secondary education (or higher) and the number of traders in Van Hoi as well as age.

In interpreting our results we remind that Van Hoi is the network we considered to have highest resilience. More specifically, it had the highest number of trading links with the majority of farmers using 2 or more traders. While, therefore, we do not see a significant effect of risk aversion on network structure across all villages there is a potentially important and interesting effect at the margin. In particular, Pham Tran and Van Duc (see Figure 5) have less resilient networks and it may be that geographical, cultural and historical factors create constraints that mean risk attitudes are less relevant in determining the trading network. In Van Hoi, by contrast, we see evidence that those who are risk averse appear to seek out further trading opportunities.

**Result 4** *Overall we find no strong overall effect of risk preferences on trading strategy. However, in Van Hoi, the site with the most resilient trading network, we see that farmers who are risk averse are significantly more likely to engage with more traders.*

We performed an analogous analysis concerning loss aversion and procrastination. Table 5 provides the results for loss aversion. Again, in Pham Tran and Van Duc we observe no impact of loss aversion. In Van Hoi we see a statistically significant negative impact. Thus, farmers who are relatively loss averse appear to have less trading links. This finding is inconsistent with Hypothesis 3. In particular, it suggests that loss aversion may be associated with inertia in trading relationships and, thus, a reluctance to take on additional, new trading links. One explanation for this would be that loss averse farmers fear losses from changing from a current trading relationship. In studying loss aversion it is, thus,

**Table 4**. The association between households' number of traders and risk preferences.

| | **All** | **Pham Tran** | **Van Duc** | **Van Hoi** |
|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** |
| Willing to take risk | -0.0293 | 0.0621 | 0.0265 | -0.305** |
| | (0.0559) | (0.0918) | (0.0658) | (0.136) |
| Ref: Primary school | | | | |
| 1. Secondary school | 0.175* | -0.239 | -0.0168 | 0.560*** |
| | (0.103) | (0.188) | (0.135) | (0.199) |
| 2. High school and higher | 0.263 | -0.219 | 0.230 | 0.685** |
| | (0.173) | (0.310) | (0.239) | (0.329) |
| Female | -0.0922 | -0.162 | -0.0295 | -0.0434 |
| | (0.0907) | (0.158) | (0.107) | (0.201) |
| Age | 0.00412 | 0.00124 | -0.00705 | 0.0217** |
| | (0.00454) | (0.00772) | (0.00604) | (0.00971) |
| Number of household members | -0.0159 | -0.0716 | -0.0385 | 0.0318 |
| | (0.0348) | (0.0731) | (0.0425) | (0.0643) |
| Number of household labourers | 0.109* | 0.231* | 0.0661 | 0.0954 |
| | (0.0574) | (0.119) | (0.0694) | (0.112) |
| Total land used | -0.00383 | -0.0123 | 0.0317** | -0.00334 |
| | (0.00733) | (0.00796) | (0.0135) | (0.0236) |
| Proportion total income from vegetables | 0.00362** | 0.00157 | 0.00159 | 0.00589 |
| | (0.00167) | (0.00302) | (0.00194) | (0.00375) |
| Ref: Pham Tran | | | | |
| 1. Van Duc | -0.588*** | | | |
| | (0.110) | | | |
| 2. Van Hoi | 0.380*** | | | |
| | (0.116) | | | |
| Constant | 1.179*** | 1.463* | 1.188** | 1.142 |
| | (0.420) | (0.821) | (0.502) | (0.855) |
| Observations | 479 | 123 | 180 | 176 |
| R-squared | 0.185 | 0.094 | 0.077 | 0.124 |

Notes: The dependent variable is the number of traders, and independent variable is the ordinal variable of risk preferences with values ranging from 1 (not willing to take risk) to 5 (willing to take risk). Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

important to consider where farmers perceive losses may materialise.

**Result 5** *Overall we find no strong overall effect of loss aversion on trading strategy. However, in Van Hoi, the site with the most resilient trading network, we see that farmers who are loss averse are significantly less likely to engage with more traders.*

Table 6 provides our results for procrastination. Here we see some evidence of a positive relationship between procrastination and number of traders in Pham Tran. In other words those who 'delay completing work' appear to have more trading links than those who 'get things done immediately'. This is inconsistent with Hypothesis 4. Recall that the trading network in Pham Tran is dominated by a small number of traders. Potentially, therefore,

**Table 5**. The association between households' number of traders and loss preferences.

| | **All** | **Pham Tran** | **Van Duc** | **Van Hoi** |
|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** |
| Loss aversion | -0.0557 | -0.0928 | 0.0324 | -0.148** |
| | (0.0373) | (0.0602) | (0.0518) | (0.0746) |
| Ref: Primary school | | | | |
| 1. Secondary school | 0.183* | -0.278 | -0.00747 | 0.654*** |
| | (0.103) | (0.182) | (0.137) | (0.204) |
| 2. High school and higher | 0.257 | -0.317 | 0.231 | 0.641* |
| | (0.171) | (0.299) | (0.234) | (0.328) |
| Female | -0.115 | -0.155 | -0.0117 | -0.116 |
| | (0.0910) | (0.156) | (0.110) | (0.201) |
| Age | 0.00397 | 0.000124 | -0.00682 | 0.0188* |
| | (0.00453) | (0.00760) | (0.00605) | (0.00959) |
| Number of household members | -0.00903 | -0.0629 | -0.0400 | 0.0624 |
| | (0.0350) | (0.0727) | (0.0426) | (0.0650) |
| Number of household labourers | 0.103* | 0.224* | 0.0659 | 0.0558 |
| | (0.0574) | (0.118) | (0.0693) | (0.114) |
| Total land used | -0.00396 | -0.0121 | 0.0320** | -0.00693 |
| | (0.00731) | (0.00790) | (0.0135) | (0.0236) |
| Proportion total income from vegetables | 0.00359** | 0.00198 | 0.00162 | 0.00576 |
| | (0.00166) | (0.00300) | (0.00194) | (0.00377) |
| Ref: Pham Tran | | | | |
| 1. Van Duc | -0.594*** | | | |
| | (0.109) | | | |
| 2. Van Hoi | 0.373*** | | | |
| | (0.115) | | | |
| Constant | 1.257*** | 2.075*** | 1.162** | 0.504 |
| | (0.377) | (0.697) | (0.469) | (0.745) |
| Observations | 479 | 123 | 180 | 176 |
| R-squared | 0.189 | 0.109 | 0.078 | 0.119 |

Notes: The dependent variable is the number of traders, and independent variable is the ordinal variable of loss preferences with values ranging from 1 (fully disagree) to 5 (fully agree). Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

the 'default' in Pham Tran is to trade with a main trader and so those who 'get things done immediately' simply end up trading with one of the main traders. If so, procrastination may be beneficial for network resilience because it ultimately results in diversification through a reluctance to switch to a dominant trader. This conjecture could be explored further in future work.

**Result 6** *Overall we find no strong overall effect of procrastination on trading strategy. However, in Pham Tran, the site with a small number of dominant traders, we see that farmers who procrastinate are significantly more likely to engage with more traders.*

Results 4-6 reaffirm the importance of considering heterogeneity across different sites

**Table 6**. The association between households' number of traders and procrastination.

| | **All** | **Pham Tran** | **Van Duc** | **Van Hoi** |
|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** |
| Get things done immediately | -0.111* | -0.264** | -0.0196 | -0.0880 |
| | (0.0594) | (0.101) | (0.0710) | (0.129) |
| Ref: Primary school | | | | |
| 1. Secondary school | 0.138 | -0.398** | -0.0271 | 0.531** |
| | (0.105) | (0.185) | (0.137) | (0.208) |
| 2. High school and higher | 0.237 | -0.372 | 0.202 | 0.564* |
| | (0.172) | (0.294) | (0.231) | (0.336) |
| Female | -0.0914 | -0.176 | -0.0247 | -0.0736 |
| | (0.0901) | (0.153) | (0.108) | (0.203) |
| Age | 0.00346 | -0.00299 | -0.00729 | 0.0175* |
| | (0.00454) | (0.00757) | (0.00603) | (0.00968) |
| Number of household members | -0.0149 | -0.0675 | -0.0364 | 0.0399 |
| | (0.0346) | (0.0709) | (0.0425) | (0.0652) |
| Number of household labourers | 0.107* | 0.206* | 0.0662 | 0.0871 |
| | (0.0572) | (0.116) | (0.0694) | (0.114) |
| Total land used | -0.00304 | -0.0113 | 0.0317** | -0.00391 |
| | (0.00732) | (0.00776) | (0.0135) | (0.0241) |
| Proportion total income from vegetables | 0.00368** | 0.00191 | 0.00155 | 0.00611 |
| | (0.00166) | (0.00294) | (0.00195) | (0.00382) |
| Ref: Pham Tran | | | | |
| 1. Van Duc | -0.599*** | | | |
| | (0.109) | | | |
| 2. Van Hoi | 0.372*** | | | |
| | (0.115) | | | |
| Constant | 1.567*** | 3.176*** | 1.390*** | 0.463 |
| | (0.445) | (0.848) | (0.511) | (0.918) |
| Observations | 479 | 123 | 180 | 176 |
| R-squared | 0.191 | 0.142 | 0.077 | 0.100 |

Notes: The dependent variable is the number of traders, and independent variable is the ordinal variable of time preferences with values ranging from 1 (delayed in completing work) to 5 (having work done immediately). Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

and the dangers of extrapolating findings from one site. We remind (Result 2) that in three apparently similar villages we saw evidence of three very different trading networks. We now see evidence that the different networks, and social and cultural environment, in these three villages seemingly mean that risk and time preferences have different implications for trading strategy. In Van Hoi, where there is the most trading links, proportionally most traders and highest resilience, we found evidence that risk aversion and loss aversion are related to trading strategy. Thus, in settings where there are more choices in trading strategy we find evidence that risk preferences are important. In Pham Tran, where the network is dominated by a small number of traders we found evidence that procrastination is associated with more trading links. We conjectured that in areas with limited trading

strategies procrastination may be beneficial for resilience because it 'delays' the emergence of dominant sellers. Each site, therefore, has its own unique set of circumstances that need to be considered.

# 5 Conclusion

In this paper we have analysed the trading network of small scale vegetables farmers in Vietnam. Small scale farmers are highly reliant on intermediary traders to bring their product to market and earn income. The trading network, therefore, has far reaching implications, ranging from poverty alleviation and redistribution in rural communities, to food security of global supply chains. A network is not resilient if the inability of a node (i.e. trader) or link (i.e. interaction between farmer and trader) to function would have significant negative implications for farmers and traders. To a rough approximation, networks with more links and more nodes (particularly traders) are more resilient (Dolfing, Leuven and Dermody, 2019). We conjectured that risk preferences and procrastination could impact the trading network. For instance, risk aversion may cause inertia in new link formation, and result in a less resilient trading network. While recent results suggest that loss aversion is associated with the adoption of innovation to avoid loss (He et al., 2019; Jin et al., 2020; Visser, Jumare and Brick, 2020).

We conducted field research at three separate sites in Vietnam, collecting data from over 400 small scale farming households. For each household we obtain data on trading strategy and a range of psychological measures including risk aversion and procrastination. We find that the trading network in all three villages is not resilient, with a typical farmer engaging with only one or two traders. Interestingly, however, each of the three sites, despite their apparent similarities, have very different network structures and characteristics. For instance, in one village, Pham Tran, trading is dominated by only 3 traders while in another, Van Hoi, there are relatively far more traders and trading links. These differences across three apparently similar villages should caution against the extrapolation of results from one setting to another, and motivate further studies mapping network structure. It also, suggests that the trading network is determined by a combination of geographical, historical and cultural factors.

Our key research aim was to explore the relationship between behavioural factors and trading strategy. In one of the villages, Van Hoi, the village with the most resilient network, we find a strong positive relationship between risk aversion and the number of traders the household engages with. This suggests that risk aversion is improving network resilience by leading to diversification of trading strategies. We also found evidence in Van Hoi that loss averse is negatively related to the number of traders. This result contrasts with recent studies suggesting loss aversion can lead to innovation. In another village, Pham Tran, We found evidence that procrastination is related to engagement with more traders. We suggest that this result may stem from Pham Tran having a small number of dominant traders. Thus, procrastination may improve resilience by 'delaying' the spread of dominant traders and, thus, diversifying the set of trading links.

Given that the trading network at all three villages we studied was not resilient, it is a pressing policy challenge as to how resilience can be strengthened. This would require more trading links in the network, and not necessarily more traders. We conjecture that link formation is held back by a range of factors including reluctance to change contracts, and the social and time costs of maintaining a link between household and trader. One way to potentially alleviate these barriers to link formation is through real time, crop quality monitoring. This would reduce contract uncertainty and reduce the time needed for traders to spend in the field. Insurance would also facilitate farmers to engage with new traders. We believe, therefore, that policy makers should consider a package of measures to support the use of monitoring technology in the field, potentially accompanied by some form of insurance against loss.

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# A Supplementary Material

In Figure 6 we summarise the location of the three study sites.

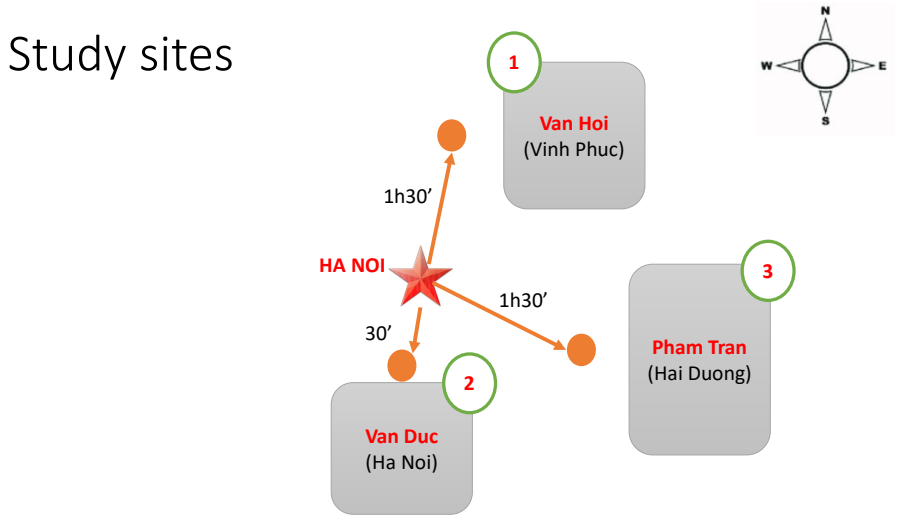


**Figure 6**. The sites' location. The number in the Figure indicates the time from the corresponding village to the capital, Hanoi.

In Table 7 we report the mean level of preferences across the three villages. You can see that we observe consistent measures across the three villages.

**Table 7**. Summary statistics of respondents and households' risk and time preferences.

| | **Pham Tran** | **Van Duc** | **Van Hoi** | **All** |
|---|---|---|---|---|
| **Risk preference** | | | | |
| Willing to take risks | 4.08 | 4.17 | 4.26 | 4.18 |
| | (0.86) | (0.80) | (0.64) | (0.76) |
| Avoid uncertainty in business | 4.34 | 4.18 | 4.40 | 4.30 |
| | (0.64) | (0.85) | (0.64) | (0.72) |
| If business suffers willing to invest | 4.05 | 4.01 | 4.18 | 4.08 |
| | (0.86) | (0.75) | (0.80) | (0.80) |
| More concerned with losses than gains | 3.36 | 3.34 | 3.36 | 3.35 |
| | (1.23) | (1.03) | (1.19) | (1.14) |
| **Time preference** | | | | |
| Willing to give up today for future | 3.92 | 4.02 | 3.68 | 3.87 |
| | (0.87) | (0.88) | (1.01) | (0.94) |
| Get things done immediately | 4.10 | 3.99 | 4.08 | 4.05 |
| | (0.75) | (0.72) | (0.70) | (0.72) |
| Usually get distracted | 3.44 | 3.18 | 2.91 | 3.15 |
| | (1.01) | (1.06) | (1.15) | (1.10) |
| N | 123 | 180 | 176 | 479 |

Notes: We report mean (standard deviation) where 1 is strongly disagree and 5 is strongly agree.

| QUESTIONNAIRE<br>FOR VEGETABLES PRODUCER [HOUSEHOLD] | |
|---|---|
| *Interviewee* | *Address:* |
| *Household head?* 0) No 1) Yes | *Date* |
| *Phone:* | *Interviewer:* |

**I. HOUSEHOLD GENERAL INFORMATION**

**1.1. Number of members: _____**

**1.2. Number of labours_____**

| | **Relationship with household head**<br>*1) Wife/Husband*<br>*2) Son/daughter*<br>*3) Father/mother*<br>*4)Grandchild*<br>*5)Other (specify)* | **Gender** | **Education**<br>*1) Primary*<br>*2)Secondary*<br>*3)Highschool*<br>*4) College*<br>*5) Graduate* | **Age** | **Current job** |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |

**1.3. Vegetable share of the total income of the household: _____(unit:%)**

**II. VEGETABLES PRODUCTION**

**2.1 Land**

| | **Total agricultural land ($m^2$)** | **Land or vegetables ($m^2$)** | **Land for others farming activities ($m^2$)** | **Rental/borrowed land for vegetable ($m^2$)** | **Agriculture land for lease/borrow ($m^2$)*** |
|---|---|---|---|---|---|
| *Plot 1st* | | | | | |
| *Plot 2nd* | | | | | |
| *Plot 3rd* | | | | | |
| *Plot 4th* | | | | | |
| ***Total*** | | | | | |

**** Reason for having land for rent or borrowed:***

*1: Lack of labour* *2: Ineffective production (doesn't bring good income)*

*3: Don't want to do farming* *4: Other reason (specify)_____*

**2.2. Labour**

Have you hired labour for vegetables farming? 1) Yes 0) No

If Yes, how much? **(Ask for each crop if it is necessary): ……. VND**

**Percent of hired labour cost of total revenue (Ask for each crop if it is necessary) …… ……..%**

**3. Scale of vegetable production**

| **TT** | **Vegetables** | **Number of crops per year** | **Size ($m^2$)** | | | **Yield (kg)** | | | **Notes** |
|---|---|---|---|---|---|---|---|---|---|
| | | | **Crop 1** | **Crop 2** | **Crop 3** | **Crop 1** | **Crop 2** | **Crop 3** | |
| **1** | | | | | | | | | |
| **2** | | | | | | | | | |
| **3** | | | | | | | | | |
| **4** | | | | | | | | | |
| **5** | | | | | | | | | |

**IV. SELLING PROCESS**

**4.1 In your household, who is the one in charge (decide) of selling? Fill answer in the table bellow**

| **TT** | **Selling method** | **Wife** | **Husband** | **Both** |
|---|---|---|---|---|
| **1** | Sell at the local market | ☐ | ☐ | ☐ |
| **2** | Sell to local collectors/traders/merchants | ☐ | ☐ | ☐ |

**4.2 Buyers and price:**

| TT | Kind of vegetables | Sell to whom? (% on total crop) | | | Frequency of active contact of household? *(Score from 1-10)*[1] | Price (per kg) | | | Who offers price? *(1= Household. 0 = Buyer)* |
|---|---|---|---|---|---|---|---|---|---|
| | | Local collectors /traders/ merchants | Co-operative | Local Market | | Min | Max | average | |
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |

**How did you know the price is reasonable (or a good price)?**

**How many steps do you estimate before your products reach the customers?**

[1] In 10 contacts, how many contacts that vegetable households actively offered their products to buyers?

**4.3 Characteristic of buyers**

| (a) Name of the buyer *(Important ranking, 1st is the buyer who you prefer to sell most)* | (b) Targeted type of products *(1) Multi (2) Single* | (c) Frequency *0) unstable*[2] *1) stable* | (d) Frequency in term of buying volume *0) Not steady 1) Steady* | (e) Buying volume (*) | | | (f) Percentage | (g) Relationship *(1= relative; 0=Not relative)* | (h) Duration of the contact with HHs *(Unit: Years)* |
|---|---|---|---|---|---|---|---|---|---|
| | | | | If (d) = 0 | Max = | Min = | | | |
| | | | | If (d) = 1 | average = | | | | |
| | | | | If (d) = 0 | Max = | Min = | | | |
| | | | | If (d) = 1 | average = | | | | |
| | | | | If (d) = 0 | Max = | Min = | | | |
| | | | | If (d) = 1 | average = | | | | |
| | | | | If (d) = 0 | Max = | Min = | | | |
| | | | | If (d) = 1 | average = | | | | |
| | | | | If (d) = 0 | Max = | Min = | | | |
| | | | | If (d) = 1 | average = | | | | |

(*) If: (d) **Unstable** -> ask the min and max of buying volume
**Stable** -> ask the average of buying volume

**V. RECOMMENDATION FOR BETTER BUSINESS**

**5.1. Are you willing to adopt new marketing channel?**

*0. Don't accept* *1. Accept*

**5.2. Do you want to have more competition among traders?**

*0. Don't accept* *1. Accept*

**5.3. Reaction to new collectors/traders/merchants?**

*0. Don't accept* *1. Accept*

**VI. BEHAVIOUR QUESTIONS:**

On a scale from 1 to 5 (strongly disagree, disagree, neutral, agree or strongly agree), do you agree with the following:

**6.1. Compared to an average person, I am willing to give up something today to gain something in the future.**

1 2 3 4 5

**6.2. If there is something I should do, I will make sure it gets done before anything else.**

1 2 3 4 5

**6.3. When I should do something, I usually get distracted.**

1 2 3 4 5

**6.4. Compared to an average person, I would say I take more risk.**

1 2 3 4 5

**6.5. If possible, I will avoid all uncertainty in my business.**

1 2 3 4 5

**6.6. When facing a financial decision, I am more concerned about the possible losses than the possible gains.**

1 2 3 4 5