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Female migrants and online market participation in rural Southeast Asia

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Female migrants and online market participation in rural Southeast Asia

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Abstract

This research aimed to examine the factors affecting the participation of female rural-urban migrants in online marketplaces, the welfare gains and their distribution from the participation. Our analysis was based on the data of 373 female rural-urban migrants in Thailand and Vietnam. Online market participation is classified into three activities, financial transaction, trading, and business. We accounted for the endogeneity issue of online market participation in welfare impact assessment by using an instrumental variable approach. Our results show that the participation has a positive effect on the consumption of female migrants only when they participate in the complete bundle of online market activities. In addition, we also find that the poor benefit insignificantly from online marketplaces. This raises a concern of increasing welfare inequality and suggests that the poor should be supported in order not to be left behind.

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1. Introduction

The rapid use of online marketplaces has brought new economic opportunities in the developing world, especially in emerging economies where it is facilitated by advances in digital technologies and the expansion of internet access (Goldfarb & Tucker, 2019). This digital transformation has created a virtual place in which information, goods, and services are exchanged to boost economic growth (Greenstein, 2020). An online market is an internet-based inter-organizational information system that provides participating buyers and sellers with opportunities to exchange information about prices and product offerings (Bakos, 1991). It thus plays an intermediary role in facilitating and matching buyers and sellers (Troy & Michael, 1999). According to a recent report of the Asian Development Bank (ADB), digital platform business-to-consumer revenues reached US $3.8 trillion, equivalent to 4.4% of global Gross Domestic Product (GDP) in 2019. Asia accounted for about 48% of this total sales revenue (US $1.8 trillion - equivalent to 6% of its regional GDP). It is expected that Asia will continue its rise as a major player in the world's digital platform market as wider access reaches more users and generates higher revenue growth (ADB, 2021).

At the same time, rapid economic growth in several Asian countries has created opportunities for employment and education in urban centres with the financial returns higher than that in rural areas characterized by a high dependence on agriculture and high exposure to extreme climatic events. This has partly led to a considerable movement of labourers from rural areas to urban centres within their countries for work and education, even on a temporary basis. This is known as domestic migration. According to the World Bank (WB) (2016), there were about 756 million domestic migrants in 2015, which is roughly three times the size of international migrants. Rural-urban migrants are vulnerable in the new urban setting due to their low level of education and limited access to social services. As a consequence, many of them fall into poverty (Cao and Liu, 2015; Lee et al., 2021). Among them, female migrants are more disadvantaged than male ones (Llácer et al., 2007). They are even paid less than male migrants for the same job (Obermann et al., 2021). The expansion of online marketplaces might offer additional benefits to domestic migrants in several ways. They might use these online platforms to look for employment opportunities and accommodation, to participate in various online purchasing activities, or to undertake their own online business. This is especially relevant for female migrants because their time is constrained due to their various family obligations such as taking care of children and purchasing food. However, so far no empirical evidence is known

about the factors facilitating or hindering the participation of female rural-urban migrants in online marketplaces, the welfare gains for them from the participation, and the distribution of the welfare gains.

Thailand and Vietnam are suitable places to examine these issues. Both countries are emerging economies which prior to the Covid-19 pandemic had relatively high rates of economic growth (Waibel at al., 2020). Thus, a relatively high number of migrants moved from rural areas to urban centres (i.e., Bangkok metropolitan area in Thailand and Ho Chi Minh City in Vietnam) for employment and education (Nguyen et al., 2019). Both countries are members of the Association of Southeast Asian Nations (ASEAN) and implementing the ASEAN Information and Communication Technology (ICT) Master Plan 2020. Thailand is undertaking the Thailand 4.0 strategy aimed to achieve economy-wide growth and innovation by creating an integrated digital economy. Vietnam has also identified ICT as an important factor for economic growth. Both countries have experienced rapid growth in online market development (ITU, 2020; ADB, 2021). Nevertheless, these two countries are also distinct in several aspects. Thailand is an upper-middle income economy while Vietnam is a lower middle-income one. However, the share of internet users of the population has been higher in Vietnam than in Thailand since 2006 (ITU, 2020).

Against this background, our research thus aims to address the following research questions (i) what are the factors affecting the participation of female migrants in online marketplaces?, (ii) how much are the welfare gains from online marketplace participation?, and (iii) how are the welfare gains distributed? Addressing these questions provides useful information for policy responses to design specific programs for this vulnerable population group to further benefit from online market development for an efficient and inclusive economic growth. We used a unique migrant dataset linked to a dataset of rural households and villages where the migrants come from to examine these issues. We employed an econometric estimation strategy that accounts for endogeneity in welfare impact assessment to achieve robust estimation results.

The rest of the paper is structured as follows. Section two outlines the conceptual framework in which potential factors affecting the decision of participating in online markets and the mechanisms through which online marketplaces affect welfare of the participants are conceptualized, reviews the evidence from the previous literature, and highlights our contributions. Section three describes the study sites and data. Section four explains the

methodology. Section five presents the results and discusses the findings. Section six concludes.

2. Conceptual framework and literature review

2.1. Conceptual framework

We start with a female rural-urban migrant. Her decision to migrate depends on several factors which are, in the migration literature, classified as "push" factors from the area of origin (her rural household and village), and "pull" factors from the area of destination (the city where she moved to). Several authors find that the decision to migrate from a rural area to an urban centre reflects not only the goals or needs of the migrant, but also a livelihood strategy of the rural household (Stark & Bloom, 1985; Rozelle et al., 1999). Once in the city, her participation in online marketplaces is dependent on her perceived net benefit from the participation, which is assumed to be positive when the decision to participate is made. The perceived net benefit is, in its turn, dependent on several factors including her characteristics such as age, education level, marital status, wealth, and employment (Santouridis & Kyritsi, 2014). This conceptualization allows us to link the activities undertaken by the migrant (i.e. participation in online marketplaces) to not only her characteristics, but also to the characteristics of the places of origin and destination (Taylor et al., 2003; Nguyen et al., 2019) and to identify the factors affecting her decision to participate in online markets.

One of the most visible differences between men and women is the time devoted to unpaid care work for their families. This unpaid care work is both an important aspect of economic activity and an indispensable factor contributing to the well-being of individuals, their families and societies (Stiglitz et al., 2007). According to a report of the Organization for Economic Cooperation and Development (OECD), around the world, women spend two to ten times more time on unpaid care work than men (OECD, 2014). The unpaid care work includes not only home activities such as cooking, cleaning and caring for children, the ill and the elderly, but also outside activities such as purchasing foods, clothes, and various other items needed for their families. This is in addition to their paid activities, thus creating the "double burden" of work for women. Moreover, women are in several cases paid less than men for the same job (Obermann et al., 2021). The situation might even be worse for rural-urban migrants due to the lack of support from their relatives who are still in rural villages. In this regard, the development of the internet in general and online marketplaces in particular offers new opportunities especially for women as such development enables women to purchase needed items online,

access a wealth of information for improving work skills, expand and strengthen social networks, and improve employment opportunities.

Compared to conventional markets, online markets can help their participants to save time and money, which are more limited for women. Online financial transactions such as sending or receiving money help save women's limited time and money as they do not need to go to a bank. When they offer something to sell in online markets, it is easier for potential buyers to know about their offers; and when they need to buy something, it is also more convenient for them to look for the needed goods or services, to search for lower prices, and to settle the purchases. When women undertake their own business, it is also easier for them to look for and meet with their business partners and reduce the costs for search and trade settlement (Troy & Michael, 1999; Zanello et al., 2014). In this regard, one of the potential mechanisms through which the participation in online marketplaces can help to improve the welfare of online market participants is that it reduces transaction costs (Garicano & Kaplan, 2001; Goldfarb & Tucker, 2019), which include search costs, price discovery, and trade settlement (Lee & Clark, 1996). As a consequence, this increases the disposable income. In addition, the welfare gains are supposed to be different due to the nature of online market activities. For example, welfare gains from purchasing online for personal use are different from welfare gains from becoming an online merchant. The former is purely mechanical where higher income households have more disposable income and thus can spend more in online transactions; while the latter is productive and expected to bring a certain level of income. However, participation in online markets also involves a higher risk of fraud or cheating (Bilen & Matros, 2021), which can lead to welfare losses as well. Thus, examining whether participation in online markets has a welfare-improving effect is an empirical question.

2.2. Literature review

Even though online marketplaces have become increasingly important in our daily lives, previous studies seem to have focused more on the factors affecting internet use and its welfare impact. This is because participation in online marketplaces is only possible if access to the internet is available (Howard & Mazaheri, 2009). For the determinants of internet use, previous studies show that the use of internet is driven by various factors characterizing internet users (Lera-López et al. 2011; Ojo et al., 2019). Education is found to be positively associated with internet use (Briggeman & Whitacre, 2010; Yang et al., 2021). This is explained by the lack of

knowledge or computer skills which could demotivate individuals with low education levels from using the internet. In addition, better-educated individuals could take advantage of educational resources and information on the internet to strengthen their knowledge, improve employment opportunities, and enhance their income. Meanwhile, results on the relationship between age and internet use are mixed. Chang and Just (2009) find that age is positively correlated with the probability of using the internet, whereas Briggeman and Whitacre (2010) and Lera-López et al. (2011) show that the probability of internet use decreases when age increases. Nguyen et al. (2022) demonstrate a non-linearity in the effect of age on internet use. Briggeman and Whitacre (2010) show that higher income is positively associated with a higher probability of using the internet. Occupations are found to significantly affect the decision of using the internet. Mesch and Talmud (2011) find that people working in sale sectors are more likely to use the internet than those working in the agricultural sector. Lera-López et al. (2011) point out that urbanization is one of the key determinants of internet use. In developing countries, urbanization is usually accompanied by infrastructure development for production, transportation, and telecommunication. Regarding the welfare impact of internet use, the evidence is mixed. Some authors find a positive and significant effect of internet use on income in developing countries (Bailur & Masiero, 2017), which help to reduce poverty (Chang & Just, 2009; Chen et al., 2020). Some other authors find a significant but negative income effect of internet use as labour productivity is negatively affected by adjustment costs related to learning and the relocation of labour and other activities. In addition, internet diffusion tends to benefit more people with high education levels, consequently, exacerbating income inequality (Nguyen et al., 2022).

Even though previous studies on the drivers and welfare impact of internet use provide important insight. There are several issues that need further attention. First, there is a lack of studies on the factors affecting the participation in online marketplaces of rural-urban migrants, despite some previous studies examined the effectiveness of e-business on the empowerment of women (Hossain, 2018). In rapidly growing economies, rural-urban migrants have increasingly contributed to economic growth, not only at the place of destination but also at the place of origin. Second, even less attention has been paid to female rural-urban migrants despite that they are more disadvantageous than male migrants (Llácer et al., 2007; Pujazon-Zazik & Park, 2010). Third, the impact of internet development in general and of online market development in particular should theoretically be examined from both efficiency and equity perspectives. The efficiency perspective concerns whether these developments bring gains in

total welfare. Meanwhile, the equity perspective is about how the welfare gains are distributed. Making economic growth more efficient and inclusive has always been a norm in formulation of development policies. Previous literature seems to have focused more on the efficiency issues, largely ignoring the equity issues. Last, from a methodological point of view, the decisions to migrate, to use the internet, or to participate in online marketplaces are endogenous. Participants in online marketplaces might be systematically different from non-participants. Thus, failure to account for this endogeneity issue results in biased estimates of the welfare impacts.

Hence, our study contributes to filling these research gaps. We first identified the determinants of female migrants' participation in online marketplaces. We took into account not only the characteristics of the migrants but also the characteristics of the rural households and villages where they come from and their place of destination. We then examined the welfare impact of online marketplace participation with regard to the level of consumption and poverty status of the migrants. We controlled for the potential endogeneity of the participation by using an instrumental variable (IV) approach. Last, we employed a quantile regression to examine the distribution of the gains in consumption from the participation. This allows us to see who benefit(s) more from the participation. Our findings thus contribute to enriching the literature on online marketplace participation and its welfare impact and distribution, and thus provide solid evidence for formulating policy responses to support female rural-urban migrants to take the opportunities of online marketplace development. Our findings are, therefore, expected to be relevant not only to Thailand and Vietnam but also to other rapidly growing economies in the developing world.

3. Study sites and data description

3.1. Study sites and sample

We used the data from the "*Thailand – Vietnam Socio-Economic Panel (TVSEP): Poverty dynamics and sustainable development: A long-term panel project in Thailand and Vietnam*" funded by the German Research Foundation (DFG FOR 756/2), and administered by the Leibniz University Hannover, Germany. The aim of the project is to establish a long-term database to examine and compare trends and drivers of long-term development dynamics in these two emerging economies, including economic transformation and rural-urban migration. The Northern Thailand and Central Vietnam were targeted because these regions have low

average income and poor infrastructure (Nguyen et al., 2021). In these regions, three provinces in Thailand (Buri Ram, Nakhon Phanom, and Ubon Ratchathani) and three provinces in Vietnam (Dak Lak, Ha Tinh, and Thua Thien Hue) were selected as study sites as these provinces are rural and agriculture is the primary livelihood of the population. These selected provinces are highly representative of rural population in the northern region of Thailand and the central region of Vietnam (Klasen and Waibel, 2015). The sampling procedure includes three stages following the guidelines of the United Nations Department of Economics and Social Affairs (United Nations, 2005) and is described in Nguyen et al. (2017). At the first stage, sampled sub-districts (in Thailand) or communes (in Vietnam) were selected. Then two villages per sampled sub-district or commune were chosen in the second stage based on the size of the human population. At the third stage, ten households in each sampled village were randomly chosen with equal probability. The total number of sampled households was predetermined at about 2,200 in 220 villages in each country.

There have been several survey waves since 2007. In every wave, enumerators were carefully selected based on their experience in rural household surveys. They were then intensively trained. During the survey, each enumerator carried out face-to-face interviews at, normally, respondents' house. Each interview took, on average, about two and a half hours. Since 2013, the Computer Assisted Personal Interview (CAPI) on tablets have been applied to collect information in TVSEP project. The collected information was then cross-checked for any inconsistent and implausible data by (i) survey team leaders at the spot, (ii) data checking assistants, and (iii) staff members of the data centre headquarters. During these checking processes, if there were any missing or implausible data, the responsible enumerator for that interview had to correct them by re-visiting (if possible) or calling the respondent.

Two survey instruments for the rural surveys were used for data collection, the household questionnaire for household heads and the village questionnaire for village heads. The village questionnaire records information on the economy of the village such as the distance from the village to the provincial centres, and the share of households in the village with internet access. The household questionnaire contains nine sections recording information on many aspects of the households, including education and health of household members, and income generating activities. A specific subsection was designated for migration and remittances in which information of household members who had migrated to other provinces/cities was recorded, including contact details. A migrant was defined (i) as a household member who was at least

13 years old at the time they left home, (ii) was living in the place of destination at the time of the rural survey, and (iii) had left home at the place of origin for at least one month during the reference period (from May of the previous year to April of the survey year). The most recent rural survey wave undertaken in both Thailand and Vietnam was in 2017 for 1,914 rural households in Thailand and 1,898 rural households in Vietnam.

A migrant tracking survey was conducted in 2018. From the rural survey in 2017, 1,690 individuals were identified as migrants (998 in Thailand and 692 in Vietnam) from the sampled rural households. From the contact information (addresses or phone numbers) of migrants recorded in the household survey in 2017, the TVSEP project staff called the surveyed rural households three months before the migrant survey to update the contact information of the migrants. The enumerators then contacted the migrants to arrange for an interview in urban cities where they were living. Similar to the rural household survey in 2017, this migrant tracking survey also used CAPI on tablets to record data; and the collected data were also cross-checked as in the rural household survey. The project aimed to interview all migrants identified from the rural survey. However, only 760 migrants (388 in Thailand and 372 in Vietnam) were successfully interviewed of which 373 are female. Most of the interviewed migrants were in Bangkok metropolitan area in Thailand, and in Ho Chi Minh City, Da Nang City and Hanoi Capital in Vietnam (see Figure 1). The reasons for this low response rate include (i) changes in the contact details so that it was not possible to reach the migrants, and (ii) challenging working environment, severe transportation, time constraints and high mobility of respondents (TVSEP, 2019).

A separate section (section 9) is designed in the migrant survey instrument to record information on internet use in which the migrants reported whether she used the internet during the last 12 months and for what activities that include financial transactions (e.g., transferring or receiving money (internet banking)), communication with family members and friends, entertainment (e.g., playing games, listening to music, or watching movies), online business (e.g., working with business partners online), finding information about job opportunities, online trading (e.g., online buying or selling), and searching for medical/health information. Based on the definition that online markets are the virtual places that allow participating buyers or sellers to exchange information or facilitate their transactions (Bakos, 1991; Troy & Michael, 1999), three activities are classified as online market participation: (i) financial transactions, (ii) trading, and (iii) business. The first is online banking, while the second is buying and selling,

and third is undertaking business. The village, household and migrant survey questionnaires are available for download at the TVSEP homepage (www.tvsep.de).
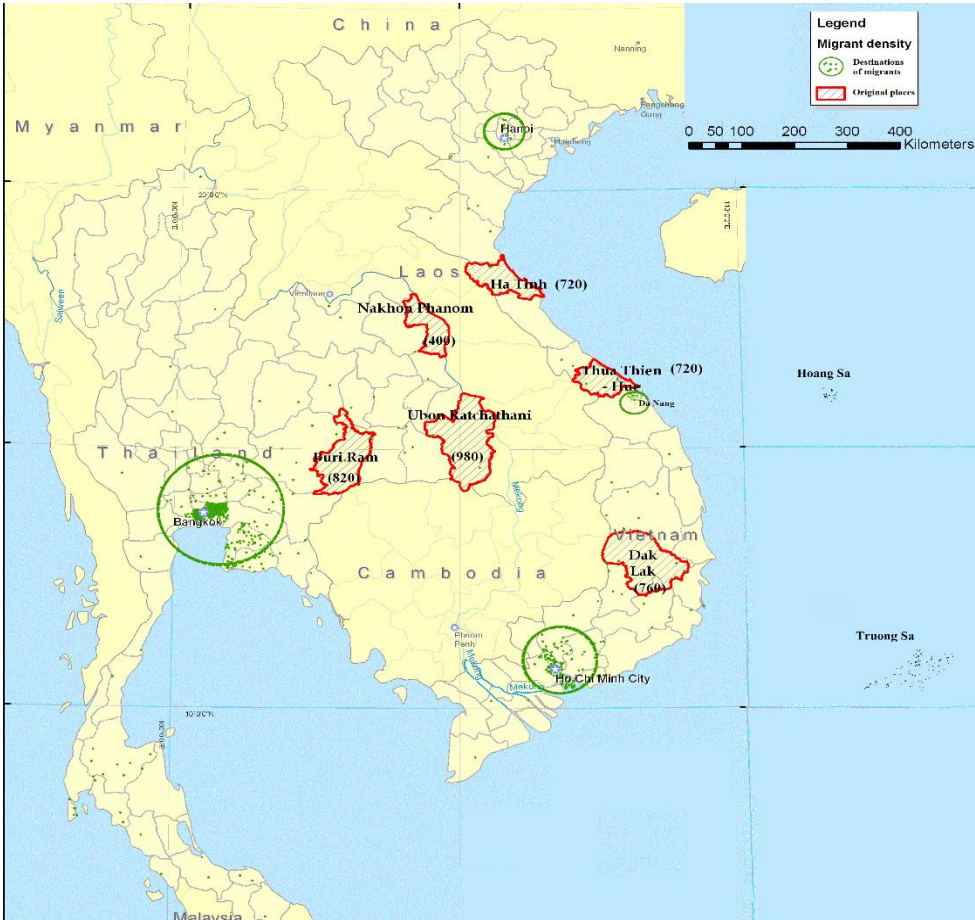
Figure 1: Study sites of rural survey (in red line) and rural-urban migrant tracking survey (in green dot)

3.2. Data description

Table 1 stacks the characteristics of migrants, rural households and villages where they come from, and the place of destination for the whole sample (including both male and female migrants), by gender (male and female) and by country (Thailand and Vietnam). The average age of migrants is about 30 years. Female migrants are younger than male ones (29 years vs 31 years), and migrants in Vietnam is younger than those in Thailand (26 years vs 33 years). The difference in age of migrants between Thailand and Vietnam is probably due to the fact that more Vietnamese migrants first migrated for educational purposes than Thai migrants. The average schooling years of migrants is about 11.4 years with no significant difference between female and male migrants. Vietnamese migrants have a higher education level than Thai migrants. There are also more Vietnamese migrants than Thai migrants first left their place of

origin for education (41% in Vietnam vs. 15% in Thailand). About one-third of Vietnamese migrants are married while this number of Thai migrants are 61%. However, the number of migrants living together with their own family (spouse and children) in the place of destination is higher in Vietnam than in Thailand (23% vs 10%). Female migrants seem to face more income shocks than male ones (48% vs 39%), and migrants in Vietnam face more income shock than those in Thailand (49% vs 38%). The average asset value of migrant for the whole sample is about PPP\$ 3,900 (Purchasing Power Parity Dollars - PPP\$) with Thai migrants owning more assets than Vietnamese migrants (PPP\$ 5,600 vs PPP\$ 2,100).

Table 1: Descriptive statistics of the characteristics of migrants and their places of origin and destination

	Whole sample (n = 760)	By gender		By country	
		Male (n = 387)	Female (n = 373)	Vietnam (n = 372)	Thailand (n = 388)
Migrant's characteristics					
Age of migrant (years)	29.84	30.53	29.12[**, a]	26.17	33.35[***, a]
	(8.76)	(8.90)	(8.56)	(6.14)	(9.43)
Education of migrant (years)	11.41	11.20	11.62[a]	12.27	10.59[***, a]
	(3.65)	(3.63)	(3.66)	(3.39)	(3.71)
Marital status of migrant[†] (yes=1)	0.49	0.51	0.46[b]	0.35	0.61[***, b]
	(0.50)	(0.50)	(0.50)	(0.48)	(0.49)
Living with family in the city[†] (yes=1)	0.16	0.17	0.16[b]	0.23	0.10[***, b]
	(0.37)	(0.38)	(0.36)	(0.42)	(0.30)
Shock experience[†] (yes=1)	0.44	0.39	0.48[**, b]	0.49	0.38[***, b]
	(0.50)	(0.49)	(0.50)	(0.50)	(0.49)
Education purposes[†] (yes=1)	0.28	0.25	0.30[b]	0.41	0.15[***, b]
	(0.45)	(0.44)	(0.46)	(0.49)	(0.36)
Accommodation sharing adults (persons)	2.51	2.49	2.54[a]	2.84	2.20[***, a]
	(1.68)	(1.68)	(1.68)	(1.84)	(1.45)
Asset value (PPP\$)	3920.46	4127.53	3705.61[a]	2152.89	5615.14[***, a]
	(7910.02)	(7853.02)	(7973.59)	(5713.85)	(9248.29)
Rural household's characteristics					
Ethnic majority[†] (yes=1)	0.96	0.96	0.96[b]	0.96	0.96[b]
	(0.20)	(0.19)	(0.20)	(0.19)	(0.20)
Mean adult education (years)	5.68	5.74	5.61[a]	5.54	5.81[*, a]
	(1.93)	(1.99)	(1.87)	(1.98)	(1.88)
Rural village's characteristics					
Share of home internet (%)	6.86	6.97	6.75[a]	10.63	3.25[***, a]
	(9.86)	(9.45)	(10.28)	(11.95)	(5.19)
Distance to provincial centre (km)	51.36	50.27	52.49[a]	41.67	60.64[***, a]
	(31.43)	(30.41)	(32.45)	(27.26)	(32.38)
Place of destination					
Metropolitan[†] (yes=1)	0.46	0.43	0.49[b]	0.47	0.46[b]
	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)

Standard deviation in parentheses; Statistic tests between gender groups and countries; [a]: Two-sample t-test; [b]: Non-parametric two-sample rank-sum test; [†]: Dummy variable; [***] $p<0.01$, [**] $p<0.05$, [*] $p<0.1$.

Regarding the characteristics of the rural households that migrants come from, more than 90% of rural households belong to the majority ethnic group in their country (Thai majority in

Thailand and Kinh majority in Vietnam). The average schooling year of adult members of rural households is 5.68 years. This shows that the migrating members are better educated than members staying at home. With regard to the characteristics of the rural villages, the share of rural households having the internet at home is relatively low, at around 7%, with Vietnam having a higher share than Thailand (10% vs 3%). The average distance from the village to the provincial centre is 41 km in Vietnam and 60 km in Thailand. There are no differences in this regard between female and male migrants. With regard to the place of destination, nearly 50% of the migrants are in metropolitan cities (i.e., Bangkok in Thailand or Ho Chi Minh City in Vietnam), and there are no differences between male and female migrants in this aspect.

Table 2 reports the descriptive statistics of migrants' consumption and their online market participation by gender and country. The average annual consumption expenditure for the whole sample is about PPP$ 4,300. Although the expenditure of male migrants is slightly higher than that of female migrants, the difference is not statistically significant. With regard to the participation in online marketplaces, more female migrants participate in financial transaction and trading activities than male ones, whereas the difference in business activities is not statistically significant between male and female migrants. There are more Vietnamese migrants participating in online trading activities. Meanwhile, the differences between Vietnamese and Thai migrants in financial transactions and business activities are not statistically significant.

Table 2: Descriptive statistics of migrants' consumption and their online market activities

	Whole sample (n = 760)	By gender		By country	
		Male (n = 387)	Female (n = 373)	Vietnam (n = 372)	Thailand (n = 388)
Annual consumption expenditure (PPP$)	4364.89	4509.31	4215.06 [a]	4286.90	4439.67 [a]
	(2991.65)	(2948.30)	(3032.66)	(2738.36)	(3217.60)
Financial transaction[†] (yes=1)	0.44	0.39	0.50[***, b]	0.44	0.45 [b]
	(0.50)	(0.49)	(0.50)	(0.50)	(0.50)
Trading[†] (yes=1)	0.47	0.41	0.53[***, b]	0.52	0.42[***, b]
	(0.50)	(0.49)	(0.50)	(0.50)	(0.49)
Business[†] (yes=1)	0.25	0.25	0.26 [b]	0.24	0.26 [b]
	(0.44)	(0.43)	(0.44)	(0.43)	(0.44)
At least 1 activity[†] (yes=1)	0.64	0.61	0.67[*, b]	0.68	0.60[**, b]
	(0.48)	(0.49)	(0.47)	(0.47)	(0.49)
At least 2 activities[†] (yes=1)	0.38	0.33	0.43[***, b]	0.38	0.37 [b]
	(0.49)	(0.47)	(0.50)	(0.49)	(0.48)
All 3 activities[†] (yes=1)	0.15	0.12	0.18[**, b]	0.14	0.16 [b]
	(0.36)	(0.33)	(0.38)	(0.35)	(0.37)

Standard deviation in parentheses; Statistic tests between gender groups and countries; [a]: Two-sample t-test; [b]: Non-parametric two-sample rank-sum test; [†]: Dummy variable; [***] $p<0.01$, [**] $p<0.05$, [*] $p<0.1$.

Table 3 shows the descriptive statistics of female migrants by their participation in online marketplace. About two-thirds of female migrants participate in at least one activity. Participants have higher expenditure, a younger age, a higher educational level, and a higher asset value than non-participants. The share of migrants coming from the ethnic majority, the average number of schooling years of adult members, and the distance from the village to the provincial centre do not show a significant difference between participants and non-participants. However, female migrants coming from rural villages with a higher share of households with home internet are more likely to participate in online marketplaces than those from the villages with a lower share of home internet.

Table 3: Descriptive statistics of female migrants by their participation in online marketplaces

	Non-participants (n = 122)		Participants (n = 251)	
	Mean	Std. Dev.	Mean	Std. Dev.
Migrant's characteristics				
Consumption expenditure (PPP$)	3278.02	1782.05	4670.52[***, a]	3392.84
Age of migrant (years)	32.81	10.91	27.32[***, a]	6.45
Education of migrant (years)	9.67	3.76	12.57[***, a]	3.21
Marital status of migrant[†] (yes=1)	0.58	0.50	0.40[***, b]	0.49
Living with family in the city[†] (yes=1)	0.22	0.42	0.12[**, b]	0.33
Shock experience[†] (yes=1)	0.43	0.50	0.51[b]	0.50
Education purposes[†] (yes=1)	0.17	0.38	0.37[***, b]	0.48
Accommodation sharing adults (persons)	2.60	1.68	2.52[a]	1.69
Asset value (PPP$)	2495.17	5435.17	4293.95[**, a]	8901.90
Rural household's characteristics				
Ethnic majority[†] (yes=1)	0.93	0.25	0.97[b]	0.18
Mean adult education (years)	5.46	1.60	5.68[a]	1.98
Rural village's characteristics				
Share of home internet (%)	4.90	7.62	7.65[**, a]	11.26
Distance to provincial centre (km)	54.21	35.11	51.65[a]	31.12
Place of destination				
Metropolitan[†] (yes=1)	0.44	0.50	0.51[b]	0.50
Thailand[†]	0.58	0.50	0.57[b]	0.50

[a]: Two-sample t-test; [b]: Non-parametric two-sample rank-sum test; [†]: Dummy variable; *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Regarding poverty, we used both absolute and relative poverty. For absolute poverty, we used a daily consumption threshold of PPP$ 5.50 per capita following the World Bank (2018) for urban residents in middle income countries. A migrant is defined to be in absolute poverty if her consumption is lower than this threshold. For relative poverty, a migrant is defined to be in relative poverty if her consumption is in the lowest 20% of the consumption distribution in each

country. Table 4 reports the descriptive statistics of consumption level and shares of absolute and relative poverty for all migrants and for female migrants. There are no significant differences in daily consumption per capita and in the share of absolute consumption poverty between male and female migrants. However, there are more female migrants in relative poverty than male migrants. For female migrants, participants in at least one online market activity tend to have a higher level of consumption and a lower incidence of poverty than non-participants.

Table 4: Consumption, absolute poverty, and relative poverty of migrants

| | Whole sample (n = 760) | By gender | | Only female migrants | |
		Male migrants (n = 387)	Female migrants (n = 373)	Not participated (n = 122)	Participated (n = 251)
Daily consumption (PPP$)	11.96	12.35	11.55 [a]	8.98	12.80[***, a]
	(8.20)	(8.08)	(8.31)	(4.88)	(9.30)
Absolute consumption poverty at PPP$ 5.50 per capita a day[†]	0.14	0.13	0.16 [b]	0.25	0.12[***, b]
	(0.35)	(0.33)	(0.37)	(0.43)	(0.33)
Relative consumption poverty (in 20% lowest consumption distribution)[†]	0.20	0.18	0.22 [b]	0.33	0.17[***, b]
	(0.40)	(0.39)	(0.42)	(0.47)	(0.38)

Standard deviation in parentheses; Statistic tests between gender groups and female migrants' participation in internet market; [a]: Two-sample t-test; [b]: Non-parametric two-sample rank-sum test; [†]: Dummy variable; *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

4. Methodology

4.1. Identifying the factors affecting the participation of female rural-urban migrants in online marketplaces

Our first step was to identify the factors affecting the participation of female rural-urban migrants in online marketplaces. As conceptualized and reviewed in Section 2, the decision of a migrant to participate is theoretically affected by several factors representing not only her characteristics but also the characteristics of her places of origin and destination. The decision to participate can be represented by a dummy variable, R, which is equal to one if she participates and equal to zero otherwise. Thus, the probability of the participation of migrant i can be estimated via a Probit regression as follows:

$$P(R_i = 1) = \alpha + \beta X_i + \gamma O_i + \delta D_i + \varepsilon_i \tag{1}$$

where P is the probability of participation; X_i is a vector representing the migrant's characteristics; O_i is a vector characterizing the original (rural) village and household where

migrant i comes from; D_i is a vector characterizing the migrant's destination (urban) place where the migrant is living and working; ε_i is the error term.

We include the following characteristics of the migrant: gender, age, education level, marital status, whether she left home for education purposes, whether she is living with her own family in the destination, whether she experienced any income shocks during the last 12 months, the number of adults with whom she is currently sharing accommodation, and her asset value. For the place of origin, we included two variables at the household level (the ethnicity dummy and the average schooling years of rural household adults), and two variables at the village level (the share of households having home internet in the village, and the distance from the village to the provincial centre). For the place of destination, we used a dummy variable indicating whether it is the Bangkok metropolitan area in Thailand or Ho Chi Minh City in Vietnam. We also included a country dummy variable to account for the unobserved differences between Thailand and Vietnam. These variables are described in more details in Appendix 1.

As we were able to interview only about a half of the migrants from the surveyed rural households, the attrition rate is high and raises a concern on our estimated results. Thus, we took a closer look on this issue. Since we did not have information of the un-interviewed migrants, we were not able to compare the differences between them and the interviewed ones. Instead, we compared the characteristics of the rural households and villages of these two groups. It appears that the un-interviewed migrants are from households with older heads, male-headed households, and poor households (daily per capita income less than PPP$ 3.20 2005). The interviewed migrants are more likely belonging to the households owning a phone. This characteristic is reasonable because the TVSEP survey contacted migrants mostly by phones. Migrants coming from households with higher education heads and from remoter villages also appear to participate more in the survey (see Appendix 2). This high attrition rate obviously impacts our estimation results and implies that our results should be interpreted with care. Thus, we tried to mitigate the effect of this problem by bootstrapping our estimation on the determinants of internet participation with 500 replications. We also checked for multicollinearity among our independent variables in estimating equation 1. The Variance Inflation Factor (VIF) values signal no serious problems of multicollinearity (Appendix 3). To have robust standard errors and to prevent the spatial autocorrelation, the standard errors of our estimations were clustered at the village level.

4.2. Examining effects of online market participation on female migrants' welfare

In the second step, the welfare effects from the participation of female migrants in online marketplaces were estimated via the following equation:

$$Y_i = \theta + \vartheta R_i + \varrho X_i + \int D_i + \eta_i \tag{2}$$

where Y_i represents a measure of the female migrant i's welfare. We used three indicators to represent the welfare of the migrants: (i) the annual consumption expenditure per capita, (ii) the absolute poverty status, and the relative poverty status. R_i, X_i, and D_i are defined as in equation 1; η_i is the error term.

One of the challenges in estimating equation 2 is that variable R_i is endogenous as explained in equation 1. We addressed this issue by employing an instrumental variable (IV) approach based on the heteroscedasticity-based identification strategy developed by Lewbel (2012) and Baum et al. (2012). The endogeneity of migrant's participation in internet market can be expressed as:

$$R_i = \phi + \Omega X_i + \pounds D_i + \omega_i \tag{3}$$

Besides the usual regression assumption that ω_i is independent from X_i, this approach assumes the existence of heteroscedasticity in ω_i, and hence in R_i. Lewbel (2012) and Baum et al. (2012) suggests using $[X_i - E(X_i)]\hat{\omega}_i$ as an internal IV for R_i in estimating equation (2), where $\hat{\omega}_i$ is the predicted residuals obtained by estimating equations (3) excluding Y_i on the right-hand side. This is a valid instrument because $[X_i - E(X_i)]\hat{\omega}_i$ is uncorrelated with η_i (Nguyen et al., 2021).

We checked for the multi-collinearity problem of independent variables in estimating equation 2. The VIF values show that there is no such problem (Appendix 4). To validate the appropriateness of the method and IVs for our estimation, we first checked for the presence of heteroscedasticity in equation 2 using two tests, namely the Breusch-Pagan/Cook-Weisberg test for heteroscedasticity and the White's test for homoscedasticity. The results of these tests (Appendix 5) confirmed the presence of heteroscedasticity. Next, we carried out several quality tests, namely the underidentification test (a LM test based on Kleibergen & Paap (2006)), the weak-identification test (Kleibergen-Paap rk Wald F statistics), and the overidentification test (Hansen J statistic test). The results of these tests presented in the lower panel of Tables 6 and

7 show that the IV are valid. Since migrants in developing countries are living under a vulnerable context, we included the interactions between online market participation and shock experience in estimating equation 2. A positive coefficient of this interaction means the participation in online market is a shock coping strategy; otherwise, their participation makes them more exposed to shocks. The robust standard errors were clustered at the village level to prevent the spatial autocorrelation.

4.3. Determining the distribution of the welfare effects

The welfare effects identified from equation 2 only provide a mean-based estimation of the effect of the participation on consumption level and poverty status of the migrants. Thus, in the last step, we further examined who benefit(s) more in terms of consumption expenditure. We followed Firpo et al. (2009) to employ an unconditional quantile regression model that include robust and clustered standard errors for this purpose. Unconditional quantile regression takes into account the effects of changes in independent variables on unconditional quantiles of dependent variables (Baltagi & Ghosh, 2017). Its main advantage is that in the presence of multiple covariates, it provides more reliable and robust results than the conventional quantile one. In addition, results from the unconditional quantile regression can be generalizable or interpretable in a context of a policy or intervention (Borah & Basu, 2013). The procedure includes two steps as explained by Borgen (2016). The first step was to obtain the recentered influence function (RIF) as:

$$RIF(Y; q_\tau, F_Y) = q_\tau + \frac{\tau - 1\{Y \le q_\tau\}}{f_Y(q_\tau)} \tag{4}$$

where q_τ is the value of the outcome variable, Y, at the quantile τ. In our case, Y is the per capita expenditure of female migrants. F_Y is the cumulative distribution function of outcome variable Y, and $f_Y(q_\tau)$ is the density of Y at q_τ. The indicator function, $1\{Y \le q_\tau\}$, identifies whether the value of outcome variable Y is below q_τ.

In the second step, the impact of online marketplace participation on consumption level of each consumption quantile was estimated as follows:

$$I[RIF(Y_i; q_\tau)|X, R] = € + £_i R_i + \oint_i X_i + ¥ D_i + \mu_i \tag{5}$$

We addressed the endogeneity concerns in equation 5 by using the same procedure as in estimating equation 2 as follows. First, we obtained the generated internal IVs from the estimation of equation 2 using the heteroscedasticity-based method. In the next step, these generated internal IVs were included in Probit models to predict the probability of participation in online marketplaces. In the final step, the instrumented and predicted probabilities were included in estimating equation 5.

5. Results and discussion

5.1. Factors affecting migrants' decision to participate in online marketplaces

We estimated equation 1 first for the whole sample (including both male and female migrants) and then for the sub-sample of only female migrants. For the whole sample, in addition to the variables described in equation 1, we included a dummy variable for gender. The results of the whole sample estimation is reported in Appendix 6. The coefficient of the gender dummy variable shows that female migrants (as compared to male migrants) use online platforms more for financial transaction and trading activities by 9.1% and 8.0%, respectively. Meanwhile, male migrants use the platforms for business activities more than female ones by 8.3%. This confirms the findings from previous studies that women and men use the internet for different purposes (Lera-López et al., 2011; Ojo et al., 2019). Education of rural households also have a positive effect on migrants' use of internet platform for transaction activities and for at least two market activities. Development of rural education is considered an engine for rural transformation (Ninh, 2021). Table 5 presents the marginal effects of the determinants of female migrants' participation in online activities by activity. We find that the first migration for educational purposes is positively associated with the participation in business activities and in all three online market activities by 11.4% and 7.5%, respectively. Age of migrants is negatively associated with the participation in online marketplaces. An increase in age by one year leads to a decrease in the probability of participation in at least one activity by 1.4%, in at least two activities by 1.2%, and in all three activities by 0.8%. An increase in age by one year results in a decrease in the probability of participation in financial transaction by 1.0% and in trading by 1.9%. These results are consistent with Fang and Yen (2006) and Ojo et al. (2019) that the older the migrants, the less likely that they use the internet, and thus participate less in online markets. The number of schooling years of migrants has a positive and significant effect on the participation. This finding is in line with Lera-López et al. (2011) and Ojo et al. (2019). Married migrants have a lower likelihood of using the internet for financial transactions, while

living with family in the city has a higher probability to use the internet for this activity. The experience of income shocks has a positive effect on female migrants' participation in business activities and in all three online market activities. The higher the number of accommodation-sharing adults, the less likely that the female migrant participates in business and in all three online market activities. Better-off migrants in terms of asset value participate more in online marketplaces. This is understandable as wealthier people have better access to ICT and the internet than poorer ones. Our finding is also in line with Shoma (2019) who report that there are many obstacles faced by female entrepreneurs in Bangladesh, and that a combination of legislatory and regulatory reform can mitigate many of the issues that prevent women gaining from and contributing to economic growth.

Table 5: Factors affecting the participation of female rural-urban migrants in online market activities (marginal effects)

	Financial transaction	Trading	Business	At least 1 activity	At least 2 activities	All 3 activities
Education purposes[†]	-0.091	0.036	0.114**	-0.027	0.011	0.075*
	(0.066)	(0.066)	(0.054)	(0.058)	(0.068)	(0.043)
Age of migrant	-0.010***	-0.019***	-0.005	-0.014***	-0.012***	-0.008**
	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)	(0.003)
Schooling years of migrant	0.046***	0.018**	0.017**	0.027***	0.027***	0.028***
	(0.008)	(0.009)	(0.008)	(0.007)	(0.008)	(0.009)
Marital status of migrant[†]	-0.132**	-0.029	-0.011	-0.051	-0.093	-0.028
	(0.057)	(0.062)	(0.054)	(0.052)	(0.057)	(0.045)
Living with family in the city[†]	0.138*	0.004	0.057	0.012	0.120	0.079
	(0.077)	(0.082)	(0.079)	(0.065)	(0.084)	(0.067)
Shock experience[†]	0.047	0.076	0.091**	0.067	0.043	0.102***
	(0.051)	(0.049)	(0.045)	(0.050)	(0.050)	(0.038)
Accommodation sharing adults	-0.014	-0.018	-0.033**	-0.012	-0.024	-0.038**
	(0.015)	(0.017)	(0.016)	(0.013)	(0.017)	(0.015)
Asset value (ln)	0.034*	0.035*	0.040***	0.035**	0.042**	0.035**
	(0.018)	(0.018)	(0.014)	(0.015)	(0.021)	(0.016)
Ethnic majority[†]	0.165	0.101	0.040	0.087	0.246**	-0.022
	(0.102)	(0.145)	(0.102)	(0.104)	(0.123)	(0.091)
Mean adult education	0.020	-0.001	0.006	0.009	0.024	-0.005
	(0.014)	(0.014)	(0.012)	(0.013)	(0.015)	(0.010)
Share of home internet	0.002	0.004	0.005**	0.004	0.004	0.003**
	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.001)
Distance to provincial centre	-0.001	-0.000	0.001	0.000	-0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Thailand[†]	0.270***	0.133*	0.149**	0.169**	0.222***	0.158***
	(0.058)	(0.075)	(0.066)	(0.067)	(0.070)	(0.047)
Metropolitan[†]	0.081	0.081	0.187***	0.096**	0.194***	0.068*
	(0.053)	(0.058)	(0.046)	(0.048)	(0.053)	(0.038)
Number of observations	373	373	373	373	373	373
Wald chi2(10)	76.42	51.09	76.01	63.62	65.13	48.57
Prob. > chi2	0.000	0.000	0.000	0.000	0.000	0.000
Pseudo R^2	0.204	0.156	0.221	0.206	0.187	0.290

Robust standard errors bootstrapped with 500 replications and clustered at rural villages in parentheses; †: Dummy variable; ln: natural logarithm; *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Regarding the characteristics of the places of origin and destination, our results show that female migrants from the ethnic majority are more likely to use the internet platform for at least two online market activities by 24.6%. The higher the share of households with internet at home in a rural village, the higher the probability that female migrants from that village participate in online business activities and in all three activities. Female migrants in metropolitan areas participate more in online business activities than those in the other places, and female migrants in Thailand participate more in online financial transaction, trading, and business activities than those in Vietnam. It also appears that female migrants living in metropolitan cities are more likely to use the internet for business activities and they have higher probabilities to use the internet for at least one activity, at least two activities, or all three activities.

5.2. Effects of participation in online marketplaces on female migrants' consumption and poverty

Table 6 and 7 report the impacts of participation in online marketplaces on female migrants' welfare with regard to (i) per capita consumption expenditure, (ii) absolute poverty status (daily consumption per capita less than PPP$ 5.50), and (iii) relative poverty status (belong to the group of 20% poorest in each country) by type and by number of activities, respectively (the estimations for the whole sample of both male and female migrants are presented in Appendix 7 for type of activities and Appendix 8 for number of activities). The results from the estimations on each type of activities show that using the internet for business activities is significant in increasing female migrants' consumption and reducing relative consumption poverty, while the effects of financial transaction and trading are not significant. Further, the results from the estimations on the number of activities show that participating only in one or two activities does not have any significant effects on consumption and poverty status. However, participating in all three online market activities has positive and significant effects in increasing consumption and reducing poverty status of female migrants. This finding remains consistent when we excluded the country dummy variable (see Appendix 9 and Appendix 10) which allows us to generalize the finding to a larger extent. Our findings are also consistent when excluding the interaction terms between internet participation and shock experience (see Appendix 11 and Appendix 12). Thus, it is important to facilitate female migrants to participate in a complete bundle of online market activities so that their welfare can be improved. Our finding is consistent with several previous studies (Bailur & Masiero, 2017; Chen et al., 2020; Galperin, & Fernanda Viecens, 2017; Nguyen et al., 2022) that internet use improves the

welfare of its users and reduces poverty. However, our finding is different from these studies that the effect is dependent on the extent of the participation.

Table 6: Effects of online market participation on welfare of female migrants by type of activities

	Expenditure (ln)			Absolute consumption poverty			Relative consumption poverty		
Financial transaction (Financial)	0.069			0.006			-0.000		
	(0.096)			(0.059)			(0.069)		
Financial*Shock experience	0.086			-0.007			-0.036		
	(0.127)			(0.078)			(0.093)		
Trading		0.044			0.029			0.040	
		(0.086)			(0.058)			(0.064)	
Trading*Shock experience		-0.023			0.030			-0.082	
		(0.114)			(0.073)			(0.096)	
Business			0.227**			-0.075			-0.132**
			(0.111)			(0.054)			(0.063)
Business*Shock experience			-0.022			0.105			0.086
			(0.137)			(0.068)			(0.076)
Education purposes†	0.160*	0.149*	0.119	-0.053	-0.056	-0.052	-0.063	-0.062	-0.050
	(0.084)	(0.085)	(0.085)	(0.046)	(0.046)	(0.047)	(0.051)	(0.051)	(0.052)
Age of migrant	0.002	0.002	0.002	0.002	0.003	0.002	0.004	0.004	0.004
	(0.006)	(0.006)	(0.006)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Schooling years of migrant	0.028**	0.033***	0.030**	-0.011*	-0.012*	-0.011*	-0.009	-0.009	-0.008
	(0.012)	(0.012)	(0.012)	(0.007)	(0.007)	(0.006)	(0.007)	(0.008)	(0.007)
Marital status of migrant†	-0.262***	-0.271***	-0.272***	0.033	0.034	0.032	0.072	0.073	0.073
	(0.086)	(0.087)	(0.087)	(0.049)	(0.049)	(0.049)	(0.057)	(0.056)	(0.056)
Living with family in the city†	0.329***	0.339***	0.329***	-0.065	-0.064	-0.063	-0.140**	-0.139**	-0.136**
	(0.094)	(0.095)	(0.094)	(0.062)	(0.061)	(0.061)	(0.067)	(0.068)	(0.068)
Shock experience†	0.030	0.089	0.064	-0.083	-0.106**	-0.111***	-0.064	-0.039	-0.096*
	(0.084)	(0.081)	(0.069)	(0.053)	(0.051)	(0.039)	(0.066)	(0.071)	(0.051)
Accommodation sharing adults	-0.130***	-0.131***	-0.125***	0.073***	0.074***	0.073***	0.076***	0.077***	0.074***
	(0.021)	(0.021)	(0.022)	(0.015)	(0.015)	(0.015)	(0.016)	(0.016)	(0.016)
Asset value (ln)	0.070***	0.070***	0.066***	-0.023**	-0.024**	-0.022**	-0.029***	-0.031***	-0.027**
	(0.018)	(0.017)	(0.018)	(0.011)	(0.010)	(0.011)	(0.010)	(0.010)	(0.011)
Thailand†	0.229***	0.256***	0.229***	-0.051	-0.054	-0.045	-0.104**	-0.112**	-0.096*
	(0.068)	(0.067)	(0.068)	(0.045)	(0.043)	(0.045)	(0.051)	(0.051)	(0.052)
Metropolitan†	0.104*	0.110*	0.069	-0.043	-0.046	-0.038	-0.033	-0.034	-0.017
	(0.063)	(0.063)	(0.066)	(0.037)	(0.036)	(0.038)	(0.044)	(0.044)	(0.045)
Constant	7.389***	7.331***	7.398***	0.304**	0.291**	0.318**	0.338**	0.331**	0.343**
	(0.257)	(0.254)	(0.262)	(0.135)	(0.133)	(0.138)	(0.163)	(0.164)	(0.165)
Number of observations	373	373	373	373	373	373	373	373	373
R^2	0.331	0.325	0.339	0.181	0.182	0.186	0.180	0.180	0.185
Prob. > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Under identification	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Over identification	0.517	0.480	0.270	0.849	0.094	0.616	0.773	0.224	0.923
Weak identification	63.664	117.532	84.827	63.664	117.532	84.827	63.664	117.532	84.827

Robust standard clustered at rural villages in parentheses; †: Dummy variable; ln: natural logarithm; *** $p<0.01$, ** $p<0.05$, * $p<0.1$; The under-identifying test is an LM test relied on the rk LM statistics (Kleibergen and Paap, 2006) with the null hypothesis stating that the model is under-identified. The over-identifying test based on the Hansen J test with the null hypothesis stating that all instruments are valid in the model. The reported values of under identification and over identification tests are p-values. The report of weak-identifying test uses the Kleibergen-Paap rk Wald F statistic.

Table 7: Effects of online market participation on welfare of female migrants by number of activities

	Expenditure (ln)			Absolute consumption poverty			Relative consumption poverty		
At least 1 activity (Internet_1)	0.025 (0.086)			-0.011 (0.069)			0.005 (0.072)		
Internet_1*Shock experience	0.122 (0.128)			0.002 (0.084)			-0.108 (0.111)		
At least 2 activities (Internet_2)		0.059 (0.094)			0.041 (0.054)			0.023 (0.061)	
Internet_2*Shock experience		0.083 (0.124)			0.014 (0.069)			-0.047 (0.080)	
All 3 activities (Internet_3)			0.421*** (0.132)			-0.092* (0.055)			-0.170*** (0.063)
Internet_3*Shock experience			-0.309** (0.152)			0.145** (0.070)			0.164** (0.079)
Education purposes†	0.151* (0.085)	0.146* (0.084)	0.119 (0.083)	-0.053 (0.046)	-0.055 (0.046)	-0.050 (0.046)	-0.061 (0.051)	-0.061 (0.051)	-0.051 (0.052)
Age of migrant	0.002 (0.006)	0.002 (0.006)	0.003 (0.006)	0.002 (0.003)	0.002 (0.003)	0.002 (0.003)	0.003 (0.003)	0.004 (0.003)	0.003 (0.003)
Schooling years of migrant	0.030** (0.012)	0.030** (0.012)	0.029** (0.012)	-0.011 (0.007)	-0.013* (0.007)	-0.011* (0.006)	-0.008 (0.007)	-0.010 (0.008)	-0.008 (0.007)
Marital status of migrant†	-0.272*** (0.088)	-0.264*** (0.086)	-0.267*** (0.087)	0.031 (0.049)	0.036 (0.048)	0.032 (0.049)	0.075 (0.056)	0.074 (0.056)	0.071 (0.055)
Living with family in the city†	0.345*** (0.093)	0.328*** (0.093)	0.323*** (0.094)	-0.064 (0.060)	-0.069 (0.061)	-0.063 (0.062)	-0.146** (0.066)	-0.140** (0.067)	-0.135** (0.068)
Shock experience†	-0.010 (0.098)	0.038 (0.078)	0.105 (0.066)	-0.087 (0.068)	-0.094** (0.045)	-0.110*** (0.036)	-0.006 (0.090)	-0.062 (0.060)	-0.102** (0.048)
Accommodation sharing adults	-0.132*** (0.021)	-0.129*** (0.022)	-0.127*** (0.022)	0.073*** (0.015)	0.075*** (0.015)	0.074*** (0.015)	0.077*** (0.016)	0.077*** (0.016)	0.076*** (0.016)
Asset value (ln)	0.071*** (0.017)	0.069*** (0.018)	0.068*** (0.018)	-0.022** (0.011)	-0.024** (0.010)	-0.023** (0.011)	-0.030*** (0.010)	-0.030*** (0.010)	-0.028*** (0.011)
Thailand†	0.248*** (0.068)	0.240*** (0.069)	0.216*** (0.067)	-0.049 (0.045)	-0.060 (0.044)	-0.045 (0.045)	-0.103** (0.051)	-0.109** (0.050)	-0.094* (0.053)
Metropolitan†	0.104* (0.063)	0.096 (0.062)	0.093 (0.064)	-0.042 (0.036)	-0.051 (0.037)	-0.043 (0.037)	-0.030 (0.043)	-0.036 (0.044)	-0.029 (0.045)
Constant	7.355*** (0.256)	7.371*** (0.264)	7.371*** (0.261)	0.310** (0.138)	0.311** (0.136)	0.322** (0.136)	0.335** (0.165)	0.342** (0.165)	0.352** (0.165)
Number of observations	373	373	373	373	373	373	373	373	373
R²	0.330	0.330	0.341	0.182	0.183	0.185	0.186	0.179	0.183
Prob. > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Under identification	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Over identification	0.422	0.214	0.655	0.421	0.204	0.749	0.923	0.445	0.738
Weak identification	85.678	74.865	84.745	85.678	74.865	84.745	85.678	74.865	84.745

Robust standard clustered at rural villages in parentheses; †: Dummy variable; ln: natural logarithm; *** $p<0.01$, ** $p<0.05$, * $p<0.1$; The under-identifying test is an LM test relied on the rk LM statistics (Kleibergen and Paap, 2006) with the null hypothesis stating that the model is under-identified. The over-identifying test based on the Hansen J test with the null hypothesis stating that all instruments are valid in the model. The reported values of under identification and over identification tests are p-values. The report of weak-identifying test uses the Kleibergen-Paap rk Wald F statistic.

While the results of the interactions between each type of internet use and income shocks are not significant, the interaction terms have a negative effect on consumption and a positive effect on both absolute and relative consumption poverty in the estimations by the number of activities. These results show that the participation of female migrants in online marketplaces is not a shock coping strategy, but it even makes them more exposed to shocks. These results are consistent with Mottaleb et al. (2019) who show that shocks in the form of commodity price hikes might more adversely affect female-headed households. The price hikes reduce expenditures on food and non-food items, and particularly cereal, non-cereal, and education

expenditures of female-headed households more than male-headed households. This reduction might make their consumption level lower than the poverty threshold. We also find that the coefficients of these interactions is only significant in the case of participating in all three online activities. This further implies that the full participation when faced with shocks increases the vulnerability of female migrants to poverty. Indeed, this is understandable since online marketplaces in developing countries are often considered informal (Rangaswamy, 2019) and less regulated. This makes online markets riskier for participants and reflects that it is necessary to take a close look at the operation of online markets. This is especially important in developing countries where the institutional arrangements to cope with shocks such as insurance are often absent or limited. Other factors that have a significant effect on either consumption or poverty status or both include the education level, marital status of the migrants, whether they are living with their own families in the place of destination or their first migration is for educational purpose, shock experience, the number of adults sharing the accommodation, and asset value.

5.3. Distribution of consumption effects of participation in online marketplaces

We further examined the distribution of consumption effects from the participation of female migrants in online marketplaces. We run separate regressions for the participation by type and number of activities (full results reported in Appendices 13 - 18). We summarized the results of all these estimations with regard to the effects of online marketplace participation on consumption expenditure in Table 8.

Table 8: Distribution of consumption effects from online market participation for female migrants

	Expenditure per capita (PPP$)				
	10th group	25th group	50th group	75th group	90th group
By type of activities					
Financial transaction	-1306.885	291.621	3459.512***	4226.006**	5880.696
	(1203.951)	(1067.337)	(1213.102)	(1943.559)	(4386.485)
Trading	-1516.338	178.751	801.593	2621.835	6348.138*
	(1514.158)	(1226.047)	(1313.353)	(1622.426)	(3687.552)
Business	-601.554	474.898	1318.119**	2468.529**	5901.840**
	(582.061)	(510.698)	(633.612)	(1043.335)	(2856.665)
By number of activities					
At least 1 activity	-1463.238	390.251	796.454	1234.902	-3517.431
	(1764.832)	(1484.155)	(1535.044)	(1888.365)	(3395.826)
At least 2 activities	-1244.415	-757.486	1844.143*	4411.170***	9385.089***
	(835.709)	(736.858)	(969.361)	(1383.727)	(3201.924)
All 3 activities	-159.469	531.389**	1122.134***	2166.841***	3394.551*
	(260.991)	(254.406)	(366.277)	(663.194)	(1877.900)

Robust standard errors clustered at rural villages in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$; Full results are presented in Appendices 13-18.

Considering each activity separately, the participation has a positive and significant effects for female migrants in the higher consumption quantile groups. More specifically, financial transaction has a positive and significant effect only for the 50th and 75th groups. The effect of trading is significant only for the 90th group, whereas the effect of business is significant for the 50th, 75th and 90th groups. The effects of each of these activities for the 10th and 25th groups are all insignificant. Considering the combination of these activities, participation in one activity has no significant effects on all groups. Meanwhile, participation in at least two activities or in all three activities brings no significant effects for the poorest group. The results imply that online market participation is benefiting the better-off, rather than the poor. While these results seem plausible as better-off individuals might be more capable of taking the opportunities, it raises a concern that the disparity between the better-off and the poor is enlarged. Similar with our results, Ma and Wang (2020) and Nguyen et al. (2022) also show that internet access has positive and significant effects on the income of individuals in the middle and the upper tail of the income distribution, whereas the impact on the poor is not significant.

6. Conclusion

Understanding the drivers and welfare effects of participation in online marketplaces in emerging countries is important in order to take the advantages of ICT development. In this study, we examined the factors affecting the participation of female rural-urban migrants in online marketplaces, its effects on consumption and poverty, and the distribution of the consumption effect. We used a dataset of 373 female migrants in Thailand and Vietnam and linked it with a dataset of rural households and villages where they come from. We employed a probit model to examine the determinants of the participation, a heteroscedasticity-based approach to account for endogeneity concern to investigate the effects on consumption and poverty, and a quantile regression model to examine the distribution of the consumption effect. Our analysis provides several important findings.

First, the participation of female migrants in online markets is driven by several factors characterizing the migrant herself, her places of origin and destination. A higher education level and a higher asset value are among the factors facilitating the participation, whereas an older age and sharing accommodation with a higher number of adults are among the factors hindering the participation. Migrants left home for education purposes are more likely to participate in online business and in all three activities. Living with family in the city appears to increase the

probability of female migrants to use the internet for financial transaction, whereas married migrants are less likely to use online financial transactions. Migrants coming from the villages with a higher share of households with internet at home or living in a metropolitan area are more likely to participate in online marketplaces.

Second, a positive effect on consumption and poverty reduction can only be realized if female migrants use the internet for business activities or they participate fully in all online market activities. However, the consumption effect of online market participation is not equally distributed, with the effect being significant only for the better off. This might enlarge the consumption gaps between the rich and the poor. Our findings thus suggest that, on the one hand, facilitating migrants to fully participate in online market activities should be undertaken. This can be done through developing rural education and supporting rural households to use the internet. On the other hand, other specific programs to support the poor segment of female migrants to improve the welfare so that they are not left behind should be established.

Last, the interaction between internet participation and income shocks has a negative effect on consumption and a positive effect on consumption poverty in the estimations by the number of activities. These results show that the participation of female migrants in internet use is not a shock coping strategy, but it even makes them more exposed to shocks. Since the online marketplaces in developing economies are often considered as informal and they are even less regulated, this makes online markets riskier for participants and calls for more attention from authorities to have appropriate measures to protect female participants in these online marketplaces.

Although our study provides important insight, it still has a number of limitations. First, our data are cross-sectional and covers only three provinces in each country. Second, our sample of rural-urban migrants in both countries has a high attrition rate, which obviously affects the estimation results. Thus, interpretation of our results should be taken with care. Third, we are not able to account for migrants' unobservable factors such as her talent and ability. Extending the coverage of the data in both temporal and spatial aspects is thus strongly suggested. In addition, it is for sure that after the Covid-19 pandemic, the participation in online marketplaces and its welfare impact might be completely different. The strict lockdown in Thailand and Vietnam in response to the pandemic might force migrants to be back to their place of origin and decrease their welfare significantly; and at the same time, since conventional markets and

supermarkets are closed, it might facilitate the participation. These issues should be taken into account in future studies.

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APPENDICES:

Appendix 1: Name, definition, and measurement of variables

Name	Measurement	Definition
A. Welfare and internet participation of rural-urban migrants		
Expenditure per capita	2005 PPP$	Annual expenditure per capita of the migrant
Financial transaction	Dummy	If the migrant uses the internet for financial transactions = 1; otherwise = 0
Trading	Dummy	If the migrant uses the internet for trading activities (buying or selling) = 1; otherwise = 0
Business	Dummy	If the migrant uses the internet for business (finding or working with business partners) = 1; otherwise = 0
At least one activity	Dummy	If the migrant uses the internet for at least one activity = 1; otherwise = 0
At least two activities	Dummy	If the migrant uses the internet for at least two activities = 1; otherwise = 0
All three activities	Dummy	If the migrant uses the internet for all three activities = 1; otherwise = 0
B. Migrant's characteristics		
Female migrant	Gender dummy	Female migrant = 1; otherwise = 0
Age of migrant	Years of age	Age of the migrant
Education of migrant	Years	Number of schooling years of the migrant
Marital status of migrant	Dummy	If the migrant is married = 1; otherwise = 0
Education purposes	Dummy	If the first migration was for educational purposes = 1; otherwise = 0
Living with family in the city	Dummy	If the migrant is currently living with her own family in the city = 1; otherwise = 0
Shock experience	Dummy	If the migrant experienced a shock in the last 12 months (07/2017 – 06/2018) = 1; Otherwise = 0
Accommodation sharing adults	Persons	Number of adults sharing accommodation with the migrant.
Asset value	2005 PPP$	Total asset value of the durable goods that the migrant owns
C. Rural household's characteristics		
Ethnic majority	Dummy	If the household head belongs to the Thai majority in Thailand or Kinh majority in Vietnam = 1; otherwise = 0
Mean adult education	Years	Average schooling years of all household adult members
D. Rural village's characteristics		
Share of home internet	Percentage	Share of households in the village having internet at home
Distance to provincial centre	Kilometres (km)	Distance from the village to provincial centre
E. Place of destination		
Metropolitan	Dummy	If the migrant is living in Bangkok (Thailand) or Ho Chi Minh City (Vietnam) = 1; otherwise = 0
Thailand	Country dummy	Thailand = 1; Vietnam = 0

Appendix 2: Descriptive summary of household characteristics between the un-interviewed and interviewed migrants

	Un-interviewed	Interviewed	Statistical test
Age of heads (years)	58.571	56.449	3.214***
	(11.052)	(9.736)	
Male heads (Yes = 1)	0.538	0.481	2.253**
	(0.499)	(0.500)	
Daily per capita income less than PPP$3.20 (Yes = 1)	0.157	0.121	2.016**
	(0.364)	(0.327)	
If the household own a phone (Yes = 1)	0.872	0.907	-2.152**
	(0.334)	(0.291)	
Number of schooling years of heads (years)	5.849	6.266	-2.038**
	(3.246)	(3.438)	
Average schooling years of household members (years)	6.039	5.983	0.359
	(2.589)	(2.373)	
Distance to provincial centres (km)	48.834	52.440	-2.254**
	(31.714	(31.830)	

Note: *** significant at 1% level; ** significant at 5% level.

Appendix 3: Variance Inflation Factor (VIF) values on the determinants of migrant's participation in internet marketplaces

Variable	VIF	1/VIF
Female[†]	1.07	0.93
Age of migrant	1.54	0.65
Education of migrant	1.69	0.59
Marital status of migrant[†]	1.76	0.57
Living with family in the city[†]	1.48	0.68
Shock experience[†]	1.07	0.93
Education purposes[†]	1.48	0.68
Accommodation sharing adults	1.12	0.89
Asset value (ln)	1.15	0.87
Ethnic majority[†]	1.04	0.96
Mean adult education	1.11	0.90
Share of home internet	1.24	0.81
Distance to provincial centre	1.17	0.85
Thailand[†]	1.78	0.56
Metropolitan[†]	1.18	0.85
Mean VIF	1.33	

†: Dummy variable; ln: natural logarithm

Appendix 4: Variance Inflation Factor (VIF) values on the impact of migrant's participation in internet marketplaces on welfare

Variable	VIF	1/VIF
Age of migrant	1.51	0.66
Education of migrant	1.62	0.62
Marital status of migrant[†]	1.72	0.58
Living with family in the city[†]	1.47	0.68
Shock experience[†]	1.06	0.95
Education purposes[†]	1.47	0.68
Accommodation sharing adults	1.11	0.90
Asset value (ln)	1.13	0.88
Thailand[†]	1.48	0.67
Metropolitan[†]	1.15	0.87
Mean VIF	1.37	

†: Dummy variable; ln: natural logarithm

Appendix 5: Tests for heteroscedasticity in the models of effects of online market participation on welfare of female migrants

Breusch-Pagan/Cook-Weisberg test for heteroscedasticity (Ho: Constant variance)	chi2(1)	Prob > chi2
Type of activities		
Financial transaction	29.29	0.000
Trading	25.21	0.000
Business	27.35	0.000
Number of activities		
At least 1 activity	23.11	0.000
At least 2 activities	27.39	0.000
All 3 activities	34.71	0.000
White's test for homoscedasticity (Ho: homoscedasticity)	chi2(70)	Prob > chi2
Type of activities		
Financial transaction	117.84	0.003
Trading	112.52	0.008
Business	105.02	0.027
Number of activities		
At least 1 activity	107.57	0.018
At least 2 activities	110.24	0.012
All 3 activities	104.55	0.029

Appendix 6: Factors affecting the participation of rural-urban migrants in online market activities (marginal effects)

	Financial transaction	Trading	Business	At least 1 activity	At least 2 activities	All 3 activities
Female†	0.091**	0.080**	-0.083*	0.035	0.071	-0.016
	(0.045)	(0.040)	(0.045)	(0.037)	(0.045)	(0.037)
Female*Education purposes	0.020	0.034	-0.033	-0.013	0.058	-0.015
	(0.058)	(0.068)	(0.054)	(0.064)	(0.057)	(0.044)
Education purposes†	-0.084	-0.046	0.165**	-0.022	-0.055	0.080
	(0.072)	(0.070)	(0.066)	(0.075)	(0.066)	(0.051)
Age of migrant	-0.005*	-0.012***	-0.002	-0.009***	-0.006**	-0.003*
	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)
Schooling years of migrant	0.036***	0.029***	0.016***	0.028***	0.030***	0.023***
	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)
Marital status of migrant†	-0.138***	-0.035	0.010	-0.078**	-0.058	-0.030
	(0.039)	(0.046)	(0.035)	(0.037)	(0.042)	(0.030)
Living with family in the city†	0.103*	0.026	0.100**	0.062	0.100	0.066*
	(0.060)	(0.062)	(0.047)	(0.055)	(0.064)	(0.040)
Shock experience†	0.038	0.072**	0.058*	0.043	0.057*	0.072***
	(0.037)	(0.031)	(0.031)	(0.032)	(0.031)	(0.025)
Accommodation sharing adults	-0.002	-0.008	-0.007	-0.009	-0.001	-0.006
	(0.012)	(0.013)	(0.011)	(0.011)	(0.014)	(0.011)
Asset value (ln)	0.044***	0.041***	0.039***	0.048***	0.040***	0.035***
	(0.011)	(0.011)	(0.009)	(0.010)	(0.012)	(0.010)
Ethnic majority†	0.164*	0.016	0.069	0.072	0.174	-0.004
	(0.088)	(0.084)	(0.092)	(0.063)	(0.106)	(0.066)
Mean adult education	0.027**	-0.002	-0.002	0.010	0.016*	-0.002
	(0.010)	(0.010)	(0.009)	(0.009)	(0.009)	(0.007)
Share of home internet	0.000	0.005***	0.003	0.005***	0.003	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Distance to provincial centre	0.000	0.000	0.000	0.001	-0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Thailand†	0.123***	0.070	0.097**	0.075	0.120**	0.090***
	(0.046)	(0.055)	(0.047)	(0.050)	(0.048)	(0.034)
Metropolitan†	0.094**	0.144***	0.201***	0.136***	0.197***	0.111***
	(0.040)	(0.039)	(0.034)	(0.038)	(0.037)	(0.027)
Number of observations	760	760	760	760	760	760
Wald chi2(10)	143.04	143.15	131.18	138.04	148.60	100.96
Prob. > chi2	0.000	0.000	0.000	0.000	0.000	0.000
Pseudo R^2	0.153	0.170	0.150	0.180	0.165	0.227

Robust standard errors bootstrapped with 500 replications and clustered at rural villages in parentheses; †: Dummy variable; ln: natural logarithm; *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Appendix 7: Effects of online market participation on welfare of rural-urban migrants by type of activities

	Expenditure (ln)			Absolute consumption poverty			Relative consumption poverty		
Financial transactions (Financial)	0.137** (0.062)			-0.041 (0.037)			-0.058 (0.042)		
Financial*Shock experience	0.083 (0.087)			0.002 (0.049)			-0.044 (0.059)		
Trading		0.099* (0.058)			-0.013 (0.037)			-0.007 (0.044)	
Trading*Shock experience		-0.075 (0.087)			0.034 (0.050)			-0.029 (0.070)	
Business			0.332*** (0.064)			-0.092*** (0.031)			-0.116*** (0.036)
Business*Shock experience			-0.083 (0.092)			0.107** (0.045)			0.055 (0.053)
Female†	-0.134*** (0.041)	-0.130*** (0.041)	-0.115*** (0.039)	0.047** (0.023)	0.045* (0.024)	0.042* (0.023)	0.059** (0.030)	0.055* (0.030)	0.052* (0.030)
Education purposes†	0.097* (0.055)	0.095* (0.056)	0.075 (0.055)	-0.044 (0.029)	-0.044 (0.029)	-0.041 (0.029)	-0.059* (0.036)	-0.056 (0.036)	-0.052 (0.037)
Age of migrant	0.004 (0.004)	0.004 (0.004)	0.004 (0.004)	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)
Schooling years of migrant	0.022*** (0.008)	0.027*** (0.008)	0.024*** (0.007)	-0.006 (0.005)	-0.008* (0.005)	-0.007 (0.004)	-0.007 (0.005)	-0.009* (0.005)	-0.009* (0.005)
Marital status of migrant†	-0.263*** (0.056)	-0.280*** (0.056)	-0.285*** (0.056)	0.054* (0.033)	0.059* (0.033)	0.061* (0.032)	0.084** (0.038)	0.092** (0.038)	0.094** (0.038)
Living with family in the city†	0.346*** (0.061)	0.359*** (0.062)	0.331*** (0.060)	-0.083** (0.040)	-0.087** (0.040)	-0.084** (0.040)	-0.141*** (0.046)	-0.146*** (0.046)	-0.138*** (0.046)
Shock experience†	0.008 (0.056)	0.084 (0.055)	0.056 (0.041)	-0.033 (0.034)	-0.050 (0.033)	-0.059** (0.025)	-0.005 (0.046)	-0.012 (0.050)	-0.037 (0.036)
Accommodation sharing adults	-0.134*** (0.014)	-0.133*** (0.014)	-0.133*** (0.015)	0.072*** (0.010)	0.072*** (0.010)	0.073*** (0.010)	0.078*** (0.011)	0.078*** (0.011)	0.077*** (0.011)
Asset value (ln)	0.060*** (0.013)	0.062*** (0.012)	0.056*** (0.013)	-0.021*** (0.007)	-0.022*** (0.006)	-0.021*** (0.006)	-0.024*** (0.007)	-0.026*** (0.007)	-0.023*** (0.007)
Thailand†	0.062 (0.048)	0.085* (0.049)	0.060 (0.048)	0.003 (0.029)	-0.003 (0.030)	0.001 (0.030)	-0.031 (0.033)	-0.042 (0.034)	-0.035 (0.034)
Metropolitan†	0.159*** (0.041)	0.162*** (0.041)	0.109*** (0.041)	-0.050* (0.026)	-0.053** (0.025)	-0.043 (0.026)	-0.050* (0.030)	-0.053* (0.029)	-0.036 (0.030)
Constant	7.672*** (0.178)	7.596*** (0.181)	7.686*** (0.172)	0.173* (0.105)	0.189* (0.103)	0.179* (0.103)	0.267** (0.119)	0.291** (0.120)	0.274** (0.117)
Number of observations	760	760	760	760	760	760	760	760	760
R^2	0.342	0.327	0.357	0.190	0.186	0.192	0.195	0.187	0.194
Prob. > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Under identification	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Over identification	0.576	0.171	0.739	0.775	0.677	0.878	0.190	0.662	0.952
Weak identification	168.500	167.578	232.806	168.500	167.578	232.806	168.500	167.578	232.806

Robust standard clustered at rural villages in parentheses; †: Dummy variable; ln: natural logarithm; *** $p<0.01$, ** $p<0.05$, * $p<0.1$; The under-identifying test is an LM test relied on the rk LM statistics (Kleibergen and Paap, 2006) with the null hypothesis stating that the model is under-identified. The over-identifying test based on the Hansen J test with the null hypothesis stating that all instruments are valid in the model. The reported values of under identification and over identification tests are p-values. The report of weak-identifying test uses the Kleibergen-Paap rk Wald F statistic.

Appendix 8: Effects of online market participation on welfare of rural-urban migrants by number of activities

	Expenditure (ln)			Absolute consumption poverty			Relative consumption poverty		
At least 1 activity (Internet_1)	0.155** (0.062)			-0.072* (0.042)			-0.096** (0.047)		
Internet_1*Shock experience	-0.003 (0.103)			0.046 (0.060)			-0.011 (0.080)		
At least 2 activities (Internet_2)		0.171*** (0.065)			-0.028 (0.035)			-0.037 (0.040)	
Internet_2*Shock experience		0.044 (0.093)			0.031 (0.050)			-0.040 (0.059)	
All 3 activities (Internet_3)			0.416*** (0.082)			-0.068* (0.039)			-0.072 (0.045)
Internet_3*Shock experience			-0.210** (0.097)			0.086* (0.045)			0.035 (0.057)
Female†	-0.128*** (0.041)	-0.133*** (0.041)	-0.128*** (0.040)	0.046** (0.024)	0.046* (0.024)	0.044* (0.024)	0.057* (0.030)	0.057* (0.030)	0.055* (0.030)
Education purposes†	0.098* (0.056)	0.084 (0.054)	0.073 (0.055)	-0.045 (0.029)	-0.043 (0.029)	-0.041 (0.029)	-0.060* (0.036)	-0.054 (0.036)	-0.054 (0.037)
Age of migrant	0.005 (0.004)	0.004 (0.004)	0.004 (0.004)	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)	0.000 (0.002)	0.001 (0.002)	0.001 (0.002)
Schooling years of migrant	0.024*** (0.008)	0.022*** (0.008)	0.022*** (0.007)	-0.007 (0.005)	-0.008 (0.005)	-0.007 (0.005)	-0.007 (0.005)	-0.008 (0.005)	-0.009* (0.005)
Marital status of migrant†	-0.270*** (0.057)	-0.271*** (0.056)	-0.276*** (0.056)	0.054* (0.033)	0.059* (0.032)	0.059* (0.032)	0.084** (0.038)	0.090** (0.038)	0.092** (0.038)
Living with family in the city†	0.349*** (0.061)	0.341*** (0.061)	0.347*** (0.061)	-0.082** (0.040)	-0.086** (0.040)	-0.087** (0.040)	-0.141*** (0.045)	-0.141*** (0.046)	-0.144*** (0.046)
Shock experience†	0.048 (0.074)	0.023 (0.051)	0.063 (0.041)	-0.061 (0.046)	-0.045 (0.031)	-0.045* (0.024)	-0.016 (0.066)	-0.008 (0.044)	-0.029 (0.034)
Accommodation sharing adults	-0.133*** (0.014)	-0.134*** (0.014)	-0.133*** (0.015)	0.072*** (0.010)	0.072*** (0.010)	0.073*** (0.010)	0.077*** (0.011)	0.078*** (0.011)	0.077*** (0.011)
Asset value (ln)	0.058*** (0.012)	0.059*** (0.013)	0.059*** (0.013)	-0.020*** (0.007)	-0.022*** (0.006)	-0.022*** (0.006)	-0.022*** (0.007)	-0.025*** (0.007)	-0.025*** (0.007)
Thailand†	0.079 (0.049)	0.065 (0.049)	0.057 (0.048)	0.000 (0.030)	-0.002 (0.030)	-0.000 (0.030)	-0.037 (0.034)	-0.035 (0.034)	-0.037 (0.034)
Metropolitan†	0.153*** (0.041)	0.137*** (0.040)	0.134*** (0.042)	-0.047* (0.025)	-0.050* (0.026)	-0.050* (0.026)	-0.043 (0.029)	-0.046 (0.030)	-0.049 (0.031)
Constant	7.588*** (0.181)	7.675*** (0.180)	7.711*** (0.176)	0.202** (0.103)	0.182* (0.105)	0.177* (0.104)	0.307** (0.120)	0.274** (0.119)	0.278** (0.120)
Number of observations	760	760	760	760	760	760	760	760	760
R^2	0.335	0.342	0.349	0.192	0.187	0.187	0.197	0.191	0.187
Prob. > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Under identification	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Over identification	0.870	0.163	0.511	0.953	0.339	0.188	0.693	0.284	0.042
Weak identification	171.267	155.610	214.921	171.267	155.610	214.921	171.267	155.610	214.921

Robust standard clustered at rural villages in parentheses; †: Dummy variable; ln: natural logarithm; *** $p<0.01$, ** $p<0.05$, * $p<0.1$; The under-identifying test is an LM test relied on the rk LM statistics (Kleibergen and Paap, 2006) with the null hypothesis stating that the model is under-identified. The over-identifying test based on the Hansen J test with the null hypothesis stating that all instruments are valid in the model. The reported values of under identification and over identification tests are p-values. The report of weak-identifying test uses the Kleibergen-Paap rk Wald F statistic.

Appendix 9: Effects of online market participation on welfare of female migrants by type of activities (country dummy excluded)

	Expenditure (ln)			Absolute consumption poverty			Relative consumption poverty		
Financial transactions (Financial)	0.092 (0.094)			0.002 (0.059)			-0.009 (0.070)		
Financial*Shock experience	0.139 (0.131)			-0.025 (0.079)			-0.070 (0.095)		
Trading		0.050 (0.088)			0.029 (0.060)			0.037 (0.064)	
Trading*Shock experience		-0.007 (0.120)			0.024 (0.076)			-0.087 (0.100)	
Business			0.253** (0.111)			-0.078 (0.052)			-0.134** (0.060)
Business*Shock experience			-0.014 (0.139)			0.101 (0.067)			0.071 (0.075)
Education purposes†	0.130 (0.084)	0.109 (0.084)	0.079 (0.084)	-0.046 (0.043)	-0.047 (0.044)	-0.044 (0.044)	-0.050 (0.050)	-0.044 (0.049)	-0.034 (0.049)
Age of migrant	0.007 (0.006)	0.007 (0.006)	0.007 (0.006)	0.001 (0.003)	0.002 (0.003)	0.001 (0.003)	0.002 (0.003)	0.002 (0.003)	0.002 (0.003)
Schooling years of migrant	0.025** (0.012)	0.033*** (0.012)	0.029** (0.012)	-0.010 (0.007)	-0.012* (0.007)	-0.011* (0.006)	-0.007 (0.007)	-0.009 (0.008)	-0.008 (0.007)
Marital status of migrant†	-0.208** (0.086)	-0.210** (0.087)	-0.219** (0.088)	0.021 (0.050)	0.021 (0.049)	0.021 (0.050)	0.048 (0.059)	0.046 (0.059)	0.051 (0.058)
Living with family in the city†	0.230*** (0.085)	0.225*** (0.085)	0.227*** (0.084)	-0.043 (0.055)	-0.040 (0.056)	-0.042 (0.055)	-0.096 (0.060)	-0.089 (0.062)	-0.093 (0.061)
Shock experience†	-0.012 (0.084)	0.063 (0.082)	0.045 (0.068)	-0.070 (0.053)	-0.099* (0.052)	-0.107*** (0.038)	-0.039 (0.068)	-0.029 (0.074)	-0.086* (0.051)
Accommodation sharing adults	-0.140*** (0.021)	-0.143*** (0.022)	-0.134*** (0.023)	0.075*** (0.015)	0.076*** (0.015)	0.075*** (0.015)	0.081*** (0.016)	0.082*** (0.017)	0.078*** (0.017)
Asset value (ln)	0.072*** (0.019)	0.073*** (0.018)	0.068*** (0.019)	-0.024** (0.011)	-0.025** (0.010)	-0.023** (0.011)	-0.030*** (0.010)	-0.032*** (0.010)	-0.028** (0.011)
Metropolitan†	0.122* (0.063)	0.134** (0.063)	0.086 (0.067)	-0.047 (0.037)	-0.051 (0.037)	-0.042 (0.039)	-0.041 (0.044)	-0.045 (0.044)	-0.024 (0.046)
Constant	7.417*** (0.261)	7.338*** (0.262)	7.415*** (0.267)	0.297** (0.136)	0.289** (0.134)	0.315** (0.139)	0.323* (0.165)	0.328* (0.169)	0.335** (0.168)
Number of observations	373	373	373	373	373	373	373	373	373
R^2	0.313	0.302	0.320	0.178	0.179	0.183	0.171	0.169	0.177
Prob. > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Under identification	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Over identification	0.683	0.575	0.177	0.713	0.200	0.738	0.706	0.325	0.939
Weak identification	90.828	135.395	107.672	90.828	135.395	107.672	90.828	135.395	107.672

Robust standard clustered at rural villages in parentheses; †: Dummy variable; ln: natural logarithm; *** $p<0.01$, ** $p<0.05$, * $p<0.1$; The under-identifying test is an LM test relied on the rk LM statistics (Kleibergen and Paap, 2006) with the null hypothesis stating that the model is under-identified. The over-identifying test based on the Hansen J test with the null hypothesis stating that all instruments are valid in the model. The reported values of under identification and over identification tests are p-values. The report of weak-identifying test uses the Kleibergen-Paap rk Wald F statistic.

Appendix 10: Effects of online market participation on welfare of female migrants by the number of activities (country dummy excluded)

	Expenditure (ln)			Absolute consumption poverty			Relative consumption poverty		
At least 1 activity (Internet_1)	0.034 (0.090)			-0.010 (0.072)			0.002 (0.074)		
Internet_1*Shock experience	0.178 (0.138)			-0.019 (0.087)			-0.135 (0.115)		
At least 2 activities (Internet_2)		0.079 (0.095)			0.037 (0.055)			0.017 (0.063)	
Internet_2*Shock experience		0.120 (0.129)			0.003 (0.073)			-0.069 (0.086)	
All 3 activities (Internet_3)			0.449*** (0.125)			-0.092* (0.050)			-0.170*** (0.056)
Internet_3*Shock experience			-0.305** (0.145)			0.137** (0.065)			0.143* (0.073)
Education purposes†	0.114 (0.084)	0.108 (0.084)	0.083 (0.083)	-0.046 (0.044)	-0.045 (0.044)	-0.043 (0.044)	-0.046 (0.049)	-0.044 (0.049)	-0.036 (0.049)
Age of migrant	0.008 (0.006)	0.007 (0.006)	0.007 (0.006)	0.001 (0.003)	0.001 (0.003)	0.001 (0.003)	0.001 (0.003)	0.002 (0.003)	0.002 (0.003)
Schooling years of migrant	0.029** (0.012)	0.029** (0.012)	0.028** (0.012)	-0.010 (0.007)	-0.012* (0.007)	-0.011* (0.006)	-0.007 (0.008)	-0.009 (0.008)	-0.008 (0.007)
Marital status of migrant†	-0.215** (0.088)	-0.207** (0.087)	-0.216** (0.087)	0.020 (0.050)	0.022 (0.049)	0.021 (0.049)	0.051 (0.058)	0.047 (0.058)	0.049 (0.058)
Living with family in the city†	0.241*** (0.082)	0.221*** (0.084)	0.227*** (0.086)	-0.044 (0.054)	-0.042 (0.055)	-0.043 (0.055)	-0.103* (0.059)	-0.091 (0.061)	-0.093 (0.062)
Shock experience†	-0.066 (0.100)	0.006 (0.077)	0.088 (0.066)	-0.069 (0.068)	-0.085* (0.046)	-0.105*** (0.036)	0.020 (0.093)	-0.045 (0.063)	-0.092* (0.049)
Accommodation sharing adults	-0.143*** (0.022)	-0.139*** (0.022)	-0.137*** (0.023)	0.075*** (0.015)	0.077*** (0.015)	0.076*** (0.015)	0.082*** (0.016)	0.081*** (0.017)	0.080*** (0.017)
Asset value (ln)	0.074*** (0.018)	0.071*** (0.019)	0.070*** (0.019)	-0.023** (0.011)	-0.025** (0.010)	-0.023** (0.011)	-0.031*** (0.010)	-0.031*** (0.010)	-0.029*** (0.011)
Metropolitan†	0.126** (0.064)	0.113* (0.062)	0.111* (0.065)	-0.046 (0.037)	-0.055 (0.037)	-0.047 (0.038)	-0.039 (0.044)	-0.044 (0.044)	-0.037 (0.045)
Constant	7.367*** (0.263)	7.388*** (0.270)	7.387*** (0.265)	0.305** (0.139)	0.306** (0.137)	0.318** (0.137)	0.329* (0.169)	0.333** (0.169)	0.342** (0.168)
Number of observations	373	373	373	373	373	373	373	373	373
R^2	0.308	0.310	0.325	0.179	0.178	0.183	0.177	0.168	0.175
Prob. > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Under identification	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Over identification	0.623	0.323	0.493	0.827	0.158	0.929	0.969	0.538	0.972
Weak identification	102.964	97.302	108.724	102.964	97.302	108.724	102.964	97.302	108.724

Robust standard clustered at rural villages in parentheses; †: Dummy variable; ln: natural logarithm; *** $p<0.01$, ** $p<0.05$, * $p<0.1$; The under-identifying test is an LM test relied on the rk LM statistics (Kleibergen and Paap, 2006) with the null hypothesis stating that the model is under-identified. The over-identifying test based on the Hansen J test with the null hypothesis stating that all instruments are valid in the model. The reported values of under identification and over identification tests are p-values. The report of weak-identifying test uses the Kleibergen-Paap rk Wald F statistic.

Appendix 11: Effects of online market participation on welfare of female migrants by type of activities (without interactions)

	Expenditure (ln)			Absolute consumption poverty			Relative consumption poverty		
Financial transactions	0.577			-0.044			-0.161		
	(0.411)			(0.179)			(0.226)		
Trading		-0.091			0.207			0.283	
		(0.371)			(0.180)			(0.213)	
Business			0.390***			-0.115			-0.122
			(0.149)			(0.076)			(0.083)
Education purposes†	0.198**	0.156*	0.092	-0.057	-0.065	-0.036	-0.075	-0.079	-0.044
	(0.089)	(0.091)	(0.090)	(0.047)	(0.050)	(0.048)	(0.055)	(0.055)	(0.054)
Age of migrant	0.006	-0.000	0.003	0.002	0.005	0.002	0.003	0.009*	0.004
	(0.006)	(0.006)	(0.006)	(0.003)	(0.004)	(0.003)	(0.004)	(0.005)	(0.003)
Schooling years of migrant	0.004	0.035**	0.026**	-0.009	-0.015*	-0.009	-0.001	-0.015*	-0.007
	(0.022)	(0.014)	(0.011)	(0.010)	(0.008)	(0.006)	(0.013)	(0.009)	(0.007)
Marital status of migrant†	-0.198*	-0.276***	-0.272***	0.026	0.041	0.032	0.052	0.085	0.073
	(0.115)	(0.092)	(0.088)	(0.054)	(0.049)	(0.050)	(0.063)	(0.059)	(0.056)
Living with family in the city†	0.265**	0.336***	0.322***	-0.059	-0.060	-0.059	-0.120	-0.134*	-0.135**
	(0.113)	(0.096)	(0.094)	(0.065)	(0.062)	(0.062)	(0.074)	(0.072)	(0.068)
Shock experience†	0.053	0.086	0.042	-0.084**	-0.103***	-0.075**	-0.075*	-0.106**	-0.071
	(0.063)	(0.068)	(0.058)	(0.034)	(0.038)	(0.035)	(0.045)	(0.050)	(0.044)
Accommodation sharing adults	-0.121***	-0.133***	-0.119***	0.072***	0.077***	0.070***	0.074***	0.081***	0.073***
	(0.021)	(0.021)	(0.023)	(0.015)	(0.015)	(0.016)	(0.016)	(0.015)	(0.017)
Asset value (ln)	0.053*	0.075***	0.061***	-0.021*	-0.030***	-0.020*	-0.024*	-0.039***	-0.026**
	(0.028)	(0.018)	(0.018)	(0.013)	(0.011)	(0.011)	(0.014)	(0.012)	(0.011)
Thailand†	0.117	0.269***	0.206***	-0.040	-0.071	-0.035	-0.070	-0.137***	-0.093*
	(0.126)	(0.069)	(0.070)	(0.061)	(0.046)	(0.046)	(0.070)	(0.053)	(0.054)
Metropolitan†	0.074	0.118*	0.035	-0.040	-0.057	-0.020	-0.024	-0.054	-0.011
	(0.072)	(0.066)	(0.068)	(0.038)	(0.039)	(0.042)	(0.047)	(0.049)	(0.048)
Constant	7.460***	7.394***	7.441***	0.297**	0.209	0.279**	0.318*	0.216	0.320*
	(0.299)	(0.272)	(0.259)	(0.137)	(0.153)	(0.136)	(0.165)	(0.201)	(0.166)
Number of observations	373	373	373	373	373	373	373	373	373
R^2	0.249	0.317	0.328	0.180	0.133	0.171	0.161	0.078	0.183
Prob. > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Robust standard clustered at rural villages in parentheses; †: Dummy variable; ln: natural logarithm; *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Appendix 12: Effects of online market participation on welfare of female migrants by number of activities (without interactions)

	Expenditure (ln)			Absolute consumption poverty			Relative consumption poverty		
At least 1 activity	-0.087			0.082			0.059		
	(0.237)			(0.171)			(0.170)		
At least 2 activities		0.496			0.008			0.141	
		(0.394)			(0.155)			(0.161)	
All 3 activities			0.280**			-0.068			-0.113*
			(0.129)			(0.056)			(0.061)
Education purposes†	0.150*	0.135	0.118	-0.052	-0.053	-0.045	-0.061	-0.067	-0.049
	(0.086)	(0.089)	(0.087)	(0.047)	(0.047)	(0.047)	(0.052)	(0.053)	(0.053)
Age of migrant	0.000	0.005	0.002	0.003	0.002	0.002	0.005	0.005	0.004
	(0.007)	(0.006)	(0.006)	(0.004)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)
Schooling years of migrant	0.036**	0.018	0.026**	-0.014*	-0.011	-0.009	-0.011	-0.014	-0.007
	(0.015)	(0.016)	(0.012)	(0.008)	(0.008)	(0.006)	(0.009)	(0.009)	(0.007)
Marital status of migrant†	-0.277***	-0.229**	-0.265***	0.037	0.033	0.030	0.076	0.085	0.070
	(0.090)	(0.106)	(0.087)	(0.050)	(0.051)	(0.049)	(0.056)	(0.058)	(0.055)
Living with family in the city†	0.337***	0.290***	0.323***	-0.064	-0.065	-0.060	-0.140**	-0.153**	-0.134**
	(0.096)	(0.109)	(0.094)	(0.062)	(0.062)	(0.062)	(0.068)	(0.068)	(0.068)
Shock experience†	0.085	0.058	0.048	-0.092**	-0.087***	-0.079**	-0.087*	-0.088**	-0.070
	(0.062)	(0.061)	(0.059)	(0.037)	(0.033)	(0.034)	(0.046)	(0.044)	(0.044)
Accommodation sharing adults	-0.132***	-0.117***	-0.124***	0.074***	0.073***	0.071***	0.077***	0.081***	0.073***
	(0.022)	(0.022)	(0.022)	(0.015)	(0.015)	(0.015)	(0.016)	(0.016)	(0.016)
Asset value (ln)	0.075***	0.054**	0.067***	-0.026**	-0.023**	-0.022**	-0.032***	-0.034***	-0.027***
	(0.020)	(0.024)	(0.017)	(0.013)	(0.011)	(0.011)	(0.011)	(0.011)	(0.010)
Thailand†	0.272***	0.164	0.220***	-0.063	-0.053	-0.041	-0.118**	-0.137**	-0.094*
	(0.074)	(0.108)	(0.068)	(0.051)	(0.052)	(0.045)	(0.059)	(0.055)	(0.052)
Metropolitan†	0.118*	0.025	0.088	-0.049	-0.044	-0.037	-0.039	-0.059	-0.025
	(0.066)	(0.080)	(0.063)	(0.036)	(0.044)	(0.037)	(0.044)	(0.054)	(0.044)
Constant	7.383***	7.389***	7.421***	0.275*	0.306**	0.288**	0.327*	0.360**	0.320*
	(0.260)	(0.281)	(0.260)	(0.148)	(0.136)	(0.133)	(0.178)	(0.163)	(0.165)
Number of observations	373	373	373	373	373	373	373	373	373
R²	0.314	0.269	0.334	0.165	0.182	0.177	0.168	0.152	0.180
Prob. > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Robust standard clustered at rural villages in parentheses; †: Dummy variable; ln: natural logarithm; *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Appendix 13: Results of quantile regressions of online market participation and female migrant's consumption for financial transaction

	Expenditure per capita (PPP$)				
	10th group	25th group	50th group	75th group	90th group
Financial transaction	-1306.885	291.621	3459.512***	4226.006**	5880.696
	(1203.951)	(1067.337)	(1213.102)	(1943.559)	(4386.485)
Education purposes†	295.025	410.072	346.484	797.993*	2595.979**
	(340.300)	(284.990)	(310.706)	(450.166)	(1062.363)
Age of migrant	6.843	-13.114	31.182*	42.361*	19.022
	(22.091)	(17.759)	(17.291)	(24.186)	(46.469)
Schooling years of migrant	127.261**	63.170	-20.078	-79.991	7.933
	(64.200)	(55.265)	(65.513)	(99.187)	(221.706)
Marital status of migrant†	-353.290	-359.591	-1020.196***	-1195.282**	-2422.956**
	(346.317)	(355.606)	(353.312)	(534.689)	(1209.607)
Living with family in the city†	427.041	645.684*	1413.132***	1831.914***	1803.514
	(400.794)	(376.068)	(467.135)	(639.618)	(1119.057)
Shock experience†	354.361*	280.889	-7.290	-382.832	-421.658
	(195.165)	(227.297)	(245.891)	(347.876)	(829.494)
Accommodation sharing adults	-385.882***	-353.754***	-357.551***	-403.287***	-442.754**
	(97.437)	(81.529)	(77.758)	(85.854)	(219.497)
Asset value (ln)	222.258**	127.914**	16.589	79.277	121.961
	(100.308)	(61.879)	(58.491)	(97.712)	(207.873)
Thailand†	355.897	430.063	244.836	766.340	3789.180***
	(338.815)	(282.311)	(319.081)	(574.843)	(1305.052)
Metropolitan†	471.602*	101.195	-93.841	418.841	180.074
	(259.309)	(239.050)	(283.968)	(380.196)	(967.835)
Constant	-549.891	1579.531*	2151.467**	2830.957***	1744.267
	(994.630)	(847.974)	(893.407)	(1059.863)	(2657.588)
Number of observations	373	373	373	373	373
R^2	0.151	0.162	0.243	0.217	0.167
F(11, 170)	3.95	7.46	14.43	10.52	3.84
Prob. > F	0.000	0.000	0.000	0.000	0.000

Robust standard errors clustered at rural villages in parentheses; †: Dummy variable; ln: natural logarithm; *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Appendix 14: Results of quantile regressions of online market participation and female migrant's consumption for trading

	Expenditure per capita (PPP$)				
	10th group	25th group	50th group	75th group	90th group
Trading	-1516.338	178.751	801.593	2621.835	6348.138*
	(1514.158)	(1226.047)	(1313.353)	(1622.426)	(3687.552)
Education purposes†	367.432	399.961	276.497	650.276	2288.157**
	(358.390)	(287.760)	(318.072)	(445.189)	(1037.815)
Age of migrant	-2.253	-12.608	24.601	49.999*	55.416
	(24.297)	(20.273)	(20.564)	(29.181)	(59.181)
Schooling years of migrant	123.081*	69.305	95.694	7.890	42.228
	(74.122)	(57.551)	(65.038)	(78.570)	(170.675)
Marital status of migrant†	-238.982	-389.352	-1408.414***	-1625.728***	-2949.979***
	(310.917)	(326.504)	(318.760)	(456.030)	(1117.138)
Living with family in the city†	272.003	678.678*	1791.312***	2310.363***	2496.385**
	(375.573)	(377.365)	(455.628)	(604.338)	(1231.722)
Shock experience†	416.176*	280.368	96.224	-392.989	-660.306
	(231.300)	(235.524)	(267.372)	(371.061)	(884.181)
Accommodation sharing adults	-391.698***	-353.641***	-365.998***	-401.414***	-420.108*
	(99.549)	(81.047)	(78.146)	(88.057)	(227.329)
Asset value (ln)	223.064**	132.459**	109.553*	144.209	132.396
	(95.626)	(63.798)	(61.090)	(91.547)	(202.799)
Thailand†	226.125	466.253*	733.920***	1289.356***	4394.652***
	(312.277)	(271.219)	(281.357)	(449.958)	(1223.046)
Metropolitan†	602.944*	97.345	70.853	358.023	-335.166
	(332.068)	(309.991)	(344.144)	(437.135)	(1064.937)
Constant	-150.244	1503.766*	1363.511	1730.374*	-14.132
	(1004.739)	(874.469)	(843.307)	(960.694)	(2461.394)
Number of observations	373	373	373	373	373
R^2	0.152	0.162	0.230	0.211	0.169
F(11, 170)	3.71	7.42	12.20	9.65	3.72
Prob. > F	0.000	0.000	0.000	0.000	0.000

Robust standard errors clustered at rural villages in parentheses; †: Dummy variable; ln: natural logarithm; *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Appendix 15: Results of quantile regressions of online market participation and female migrant's consumption for business

	Expenditure per capita (PPP$)				
	10th group	25th group	50th group	75th group	90th group
Business	-601.554	474.898	1318.119**	2468.529**	5901.840**
	(582.061)	(510.698)	(633.612)	(1043.335)	(2856.665)
Education purposes†	355.265	370.992	207.662	563.813	2084.461*
	(341.351)	(289.340)	(325.550)	(460.625)	(1086.665)
Age of migrant	11.146	-13.467	19.301	29.377	5.353
	(20.532)	(17.056)	(17.373)	(23.176)	(49.311)
Schooling years of migrant	82.807*	67.907*	101.770**	55.797	159.363
	(44.943)	(39.763)	(44.460)	(60.418)	(132.214)
Marital status of migrant†	-198.905	-393.846	-1429.031***	-1694.210***	-3115.834***
	(322.315)	(325.882)	(315.058)	(445.597)	(1115.442)
Living with family in the city†	344.997	631.269*	1656.660***	2046.950***	1865.807
	(357.976)	(379.986)	(455.410)	(619.485)	(1236.927)
Shock experience†	342.083	254.175	48.926	-388.372	-642.636
	(219.898)	(222.987)	(241.102)	(323.725)	(743.962)
Accommodation sharing adults	-389.200***	-348.055***	-352.760***	-384.940***	-381.313
	(98.208)	(82.009)	(78.642)	(89.149)	(231.075)
Asset value (ln)	192.835**	126.177**	101.160**	161.666**	176.492
	(92.039)	(55.812)	(49.360)	(72.600)	(176.024)
Thailand†	219.968	424.971	633.181**	1151.473**	4068.613***
	(311.990)	(279.190)	(277.891)	(446.497)	(1254.522)
Metropolitan†	466.234	42.847	-31.689	344.728	-354.228
	(285.250)	(271.089)	(286.247)	(393.332)	(959.404)
Constant	-398.902	1614.490*	1696.506*	2448.173**	1708.708
	(1034.866)	(884.091)	(890.093)	(984.698)	(2317.079)
Number of observations	373	373	373	373	373
R^2	0.150	0.164	0.238	0.221	0.180
F(11, 170)	3.87	7.49	12.05	9.26	3.83
Prob. > F	0.000	0.000	0.000	0.000	0.000

Robust standard errors clustered at rural villages in parentheses; †: Dummy variable; ln: natural logarithm; *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Appendix 16: Results of quantile regressions of online market participation and female migrant's consumption for at least one activity

	Expenditure per capita (PPP$)				
	10th group	25th group	50th group	75th group	90th group
At least one activity	-1463.238	390.251	796.454	1234.902	-3517.431
	(1764.832)	(1484.155)	(1535.044)	(1888.365)	(3395.826)
Education purposes[†]	273.399	416.492	326.780	780.475*	2440.658**
	(348.116)	(286.638)	(322.582)	(467.807)	(1082.191)
Age of migrant	-3.088	-10.231	25.283	37.894	-41.963
	(29.046)	(21.688)	(19.895)	(29.796)	(61.790)
Schooling years of migrant	118.098	63.279	97.632	55.842	355.976**
	(74.250)	(62.063)	(71.612)	(86.739)	(165.024)
Marital status of migrant[†]	-291.323	-369.377	-1379.291***	-1617.331***	-3342.181***
	(328.288)	(318.061)	(342.373)	(472.752)	(1151.297)
Living with family in the city[†]	354.861	658.843*	1746.451***	2226.972***	2595.309**
	(386.932)	(375.059)	(459.751)	(604.834)	(1187.558)
Shock experience[†]	368.040	274.440	120.449	-240.751	55.035
	(232.467)	(248.090)	(260.565)	(344.983)	(861.149)
Accommodation sharing adults	-392.842***	-351.661***	-365.199***	-410.411***	-497.033**
	(99.019)	(84.606)	(77.406)	(88.864)	(221.700)
Asset value (ln)	248.328**	119.041	95.099	162.620	488.964*
	(115.245)	(78.432)	(78.104)	(121.117)	(267.064)
Thailand[†]	243.713	451.337	723.270**	1335.326***	4889.742***
	(308.705)	(297.041)	(290.150)	(438.425)	(1255.177)
Metropolitan[†]	529.983	80.811	106.777	633.668	1083.370
	(332.861)	(272.289)	(281.246)	(413.806)	(977.666)
Constant	34.821	1435.444	1260.781	1686.978*	1270.564
	(1090.069)	(911.166)	(831.239)	(1000.922)	(2467.321)
Number of observations	373	373	373	373	373
R^2	0.151	0.162	0.230	0.207	0.164
F(11, 170)	3.84	7.46	12.69	9.52	3.68
Prob. > F	0.000	0.000	0.000	0.000	0.000

Robust standard errors clustered at rural villages in parentheses; †: Dummy variable; ln: natural logarithm; $^{***}p<0.01$, $^{**}p<0.05$, $^*p<0.1$.

Appendix 17: Results of quantile regressions of online market participation and female migrant's consumption for at least two activities

	Expenditure per capita (PPP$)				
	10th group	25th group	50th group	75th group	90th group
At least two activities	-1244.415	-757.486	1844.143*	4411.170***	9385.089***
	(835.709)	(736.858)	(969.361)	(1383.727)	(3201.924)
Education purposes†	371.909	444.420	215.106	530.114	2061.671**
	(347.133)	(286.843)	(322.977)	(434.233)	(1031.507)
Age of migrant	6.910	-17.545	24.819	43.796*	34.870
	(20.522)	(16.956)	(17.559)	(23.715)	(49.076)
Schooling years of migrant	116.760**	101.370**	57.944	-59.447	-75.939
	(56.801)	(46.651)	(56.406)	(73.251)	(139.465)
Marital status of migrant†	-250.215	-425.558	-1353.236***	-1512.521***	-2729.647**
	(315.584)	(326.546)	(316.522)	(454.406)	(1121.100)
Living with family in the city†	390.380	739.682**	1630.387***	1918.365***	1654.655
	(376.656)	(368.621)	(459.024)	(636.883)	(1200.181)
Shock experience†	377.878*	348.680	32.767	-486.195	-794.576
	(198.866)	(215.900)	(244.059)	(347.870)	(816.665)
Accommodation sharing adults	-389.079***	-360.224***	-359.151***	-390.264***	-402.100*
	(97.595)	(80.157)	(79.105)	(87.234)	(219.284)
Asset value (ln)	212.365**	158.563***	82.615	100.627	62.467
	(88.848)	(55.440)	(54.476)	(79.521)	(186.056)
Thailand†	308.642	566.404**	546.136*	872.097*	3541.794***
	(322.059)	(272.076)	(298.790)	(485.488)	(1200.566)
Metropolitan†	616.542**	281.353	-179.859	-129.321	-1249.212
	(283.136)	(284.089)	(334.830)	(406.767)	(1020.608)
Constant	-577.161	1336.489	1874.694**	3012.318***	2778.007
	(1043.315)	(881.672)	(922.039)	(988.842)	(2334.689)
Number of observations	373	373	373	373	373
R^2	0.152	0.164	0.237	0.230	0.183
F(11, 170)	3.90	7.79	12.46	10.02	3.84
Prob. > F	0.000	0.000	0.000	0.000	0.000

Robust standard errors clustered at rural villages in parentheses; †: Dummy variable; ln: natural logarithm; *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Appendix 18: Results of quantile regressions of online market participation and female migrant's consumption for all three activities

	Expenditure per capita (PPP$)				
	10th group	25th group	50th group	75th group	90th group
All three activities	-159.469	531.389**	1122.134***	2166.841***	3394.551*
	(260.991)	(254.406)	(366.277)	(663.194)	(1877.900)
Education purposes[†]	326.618	351.335	189.880	523.701	2174.748**
	(334.302)	(284.489)	(319.628)	(439.054)	(1081.202)
Age of migrant	11.615	-12.302	21.199	33.180	7.682
	(20.758)	(17.177)	(17.612)	(23.373)	(49.192)
Schooling years of migrant	77.074*	63.741	97.768**	46.900	176.378
	(43.621)	(39.566)	(44.377)	(60.280)	(129.990)
Marital status of migrant[†]	-201.626	-383.909	-1408.226***	-1653.992***	-3053.988***
	(321.590)	(324.413)	(314.912)	(450.504)	(1131.348)
Living with family in the city[†]	296.082	647.338*	1720.878***	2163.581***	2243.957*
	(368.731)	(373.895)	(449.912)	(606.997)	(1196.753)
Shock experience[†]	311.249	224.675	13.888	-462.667	-583.115
	(213.428)	(222.550)	(234.988)	(328.196)	(789.355)
Accommodation sharing adults	-384.063***	-342.907***	-346.479***	-371.695***	-390.183*
	(98.886)	(82.267)	(78.803)	(87.368)	(228.034)
Asset value (ln)	181.126**	127.916**	112.516**	181.724**	257.502
	(90.263)	(54.772)	(50.265)	(71.766)	(178.434)
Thailand[†]	177.283	408.154	630.451**	1138.220**	4259.420***
	(301.239)	(272.036)	(270.159)	(443.657)	(1235.937)
Metropolitan[†]	377.679	70.569	81.959	550.765	324.190
	(252.291)	(243.930)	(267.679)	(366.673)	(873.092)
Constant	-316.391	1647.797*	1703.303*	2476.768**	1343.476
	(1012.107)	(876.819)	(885.912)	(998.182)	(2475.304)
Number of observations	373	373	373	373	373
R^2	0.149	0.167	0.246	0.240	0.179
F(11, 170)	4.05	9.58	12.85	10.18	3.81
Prob. > F	0.000	0.000	0.000	0.000	0.000

Robust standard errors clustered at rural villages in parentheses; †: Dummy variable; ln: natural logarithm; *** $p<0.01$, ** $p<0.05$, * $p<0.1$.