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## Working Paper

Harnessing the potential of online marketplaces in the Philippines:  
Insights from the National Information and Communications  
Technology Household Survey

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**ADB Working Paper Series**

**HARNESSING THE POTENTIAL OF  
ONLINE MARKETPLACES IN THE  
PHILIPPINES: INSIGHTS FROM THE  
NATIONAL INFORMATION AND  
COMMUNICATIONS TECHNOLOGY  
HOUSEHOLD SURVEY**

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**Abstract**

Using the Philippines' first-ever nationally representative survey designed for characterizing digital commercial and noncommercial engagements, including ICT use, digital economy, and technology-enabled incidents, we investigate the presence of gendered disparities in online marketplaces. Doing this is consistent with the spirit of a gender and development approach that aims for equal and equitable outcomes between men and women. We verify whether the observed participation of women in online marketplaces results in higher online sales. To establish the determinants of participation and incomes in online marketplaces, we use a Heckman estimator in cognizance of the nonrandom choices people make when they enter online marketplaces. The negative selection indicates that those likely to sell have unobserved attributes negatively correlated with online income. Based on our model's income predictions, men outperform women in online sales. Men still hold the advantage, replicating a trend observed in traditional marketplaces. Results also highlight the importance of skills, digital awareness and habits, selling platforms, and ICT infrastructures. The paper also identifies potential initiatives for online marketplaces.

**Keywords:** online selling, participation, earnings, Philippines

**JEL Classification:** D390, D19

## Contents

1.	INTRODUCTION.....	1
2.	ONLINE MARKETPLACES .....	2
3.	METHODOLOGICAL APPROACH AND DATA SOURCE .....	5
4.	RESULTS AND DISCUSSION .....	12
5.	FURTHER ISSUES.....	16
6.	WAYS FORWARD .....	18
	REFERENCES .....	21
	APPENDIX.....	25

## 1. INTRODUCTION

Despite the attainment of gender parity in education in the Philippines, age-old issues such as the prevalence of unpaid work remain unresolved. In 2020, the women's labor force participation rate was 46.195%, substantially lower than men's at 75.51%.<sup>1</sup> Indeed, evidence shows that housework is the main reason for men and women not looking for work. However, the latter's percentage is substantially higher, especially for married women (Bayudan-Dacuycuy 2020). Moreover, the burden of nonmarket work has been magnified and reinforced by the ongoing pandemic due to children's online learning. Recently, advances in online tools and resources have offered flexibilities that mitigate the long-standing tension between market and nonmarket work. There are digital labor platforms that present opportunities for both men and women to earn even as they pursue other interests. In the Philippines, initial evidence indicates that women are more likely to participate in platform work, and their primary motivations include flexibility, housework, and additional income (Bayudan-Dacuycuy and Baje 2021).<sup>2</sup> Engaging in e-commerce activities has been seen to balance the playing field, reduce gender disparities in labor force participation, and provide means to improve incomes. (International Finance Corporation 2021; World Bank 2016).

Notwithstanding the positive impacts, several challenges can prevent women from fully harnessing the benefits offered by online marketplaces. The digital divide and gendered gaps in technological skills can hamper women's successful participation in economic opportunities brought about by the digital world (Bastagli and Hunt 2020; Vossenbergh 2013). Initial evidence in one major platform shows that many women-owned businesses in the Philippines are classified as microenterprises (International Finance Corporation 2021). These businesses are typically constrained by financing and have limited assets and cash reserves (Asian Development Bank 2020; Karr, Loh, and Wirjo 2020). Therefore, their digital adoption, which requires investments in physical infrastructures and human capital, may not be easy.

Given these challenges, analyzing how men and women can fully harness the opportunities in online marketplaces is worthwhile. Are there gendered differences in online incomes? What are the factors that drive the differences? How important are different skill sets in online marketplaces? To answer these questions empirically, we use the 2019 National Information and Communications Technology Household Survey (NICTHS), the first-ever nationally representative data set in the Philippines that collects information on information, communication, and technology (ICT) use and the digital economy. To our knowledge, this is the first paper that simultaneously deals with participation decisions and income outcomes in online selling. This enriches the literature by investigating the nature of gendered disparities in online selling and providing recommendations to help both men and women harness the opportunities in online marketplaces.

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<sup>1</sup> Percentage of male population 15 years old and above. Based on WDI-World Bank, modeled ILO estimate. <https://data.worldbank.org/indicator/SL.TLF.ACT1.MA.ZS?locations=PH>, retrieved 30 January 2021.

<sup>2</sup> Just like platform work, small and medium enterprises (SMEs) offer flexibilities that allow women to tackle market and nonmarket work, a goal that is embedded in the Philippine Development Plan 2017–2022 and is consistent with the Sustainable Development Goals target on women empowerment and gender equality. The ongoing local and global lockdowns have presented challenges to SMEs, and online tools and resources are providing new opportunities that allow men- and women-owned businesses to stay afloat. These include turning to online marketplaces created by e-commerce and social media platforms.

Results confirm negative selection, implying that those likely to sell have unobserved attributes negatively correlated with online income. Based on the income predictions, there are gendered disparities, with men earning more than women. This replicates the trend observed in traditional marketplaces such as the labor market. Results emphasize the importance of skills, digital awareness and habits, selling platforms, and ICT infrastructures.

The paper is organized as follows: Section 2 provides a discussion of online marketplaces, focusing on digital platforms and social media. Section 3 tackles the analytical framework, elaborating on the difference between online selling and a traditional marketplace. An empirical strategy involving selectivity correction is also discussed. Section 4 presents the marginal effects of variables on selection and income variables. Results of prediction exercises based on the parametric Heckman selection model are discussed. The exercises examine how changes in key variables would affect the incomes of male and female online sellers. Finally, Section 5 proposes ways forward to harness the potential of online selling and mitigate the observed gender gap.

## **2. ONLINE MARKETPLACES**

### **Digital Platforms and Social Media**

Alongside developments in ICT, work has become more fluid and flexible. As opportunities in the digital world become available, the resurgence of self-employment, independent employment, and freelancing in entrepreneurship is becoming more evident. As a result, new business models for online marketplaces are also gaining traction in the developing world. Online marketplaces are web-based facilities that connect various markets to facilitate the exchange of goods and services (Forde et al. 2017; Howard et al. 2006; Bakos 1997, 1998) and add value through aggregation and matching (Kaplan and Sawmhey 2000). Aggregation results in lower search costs since buyers and sellers are brought together in one marketplace (Kaplan and Sawmhey 2000; Bakos 1998), while matching results in lower prices due to arbitrage (Berg et al. 2018; Kenney and Zysman 2016).

Digital platforms, which provide opportunities to individuals and enterprises alike, are examples of online marketplaces. As defined by Kenney and Zysman (2016), platforms are sets of online digital arrangements that use algorithms to organize the conduct of business. These platforms enjoy the following advantages: 1) economies of scale or declining average costs as the number of platform users increases; and 2) network effects that enable platforms to attract an increasing number of users as more buyers and sellers join (International Telecommunication Union and World Bank 2020; Evans 2016). Often these defining features of platforms are associated with issues arising from market power brought about by concentration (Karr, Loh, and Wirjo 2020) and structural inequalities brought about by asymmetries in value, resources, risk, information, and power (Heeks 2017).

There are at least three platforms: service-providing; labor; and retail. Service-providing platforms such as Airbnb facilitate the monetization of idle assets and the exchange of financial services through alternative channels such as crowdfunding and crowdsourcing. Labor platforms, such as Upwork and Amazon Mechanical Turk, mediate work exchange. These platforms break down jobs into various simple tasks that firms can buy at lower costs due to labor arbitrage (Berg et al., 2018) and offer flexibilities that appeal to certain segments of the population, such as women (Kuek et al. 2015; Ipeirotis 2010) and the young (Berg et al. 2018). While evidence points to

greater women's empowerment resulting from platform work (Chaudhary 2020; Kuek et al. 2015), there are several issues. These include the potential deepening and widening of structural inequalities due to various asymmetries that favor platforms and firms (see Heeks, 2017), the lack of decent work such as inadequate social protection and career development (see Berg et al. 2018; Forde et al. 2017), and the persistence of earning gaps in favor of men (Payoneer 2020; Hunt and Samman 2019; Barzilay and Ben-David 2017).

Retail platforms, also referred to as capital markets in some literature (see Smith 2016), facilitate the market for goods. Global retail platforms include Amazon and eBay, while regional names include Shopee, Lazada, and Zalora. In these marketplaces, consumers benefit from the convenience and variety of goods (Duch-Brown et al. 2017), while businesses reap the efficiency, positioning, and legitimacy (Rask and Kragh 2004). The use of online marketplaces has been going on for quite some time, although the pandemic has accelerated the adoption of digital solutions for businesses to survive. Doing so has helped businesses to "manage transactions at a distance, deliver goods efficiently, facilitate access to financial services, and engage with new and existing customers" (Karr et al. 2020). Thus, some entrepreneurs have evolved into digital entrepreneurs who combine business, institutional, and knowledge entrepreneurship to bring about digital transformation (Antonizi and Smuts 2020).

However, enabling digital transformation may not be easy for some enterprises because doing so means investing in infrastructures, equipment/devices, software, and technical know-how. For example, small enterprises are limited in human, financial, and physical capital resources, which leaves them wanting on the commitment front (Cenamor et al. 2019; Giotopolous et al. 2017). There are also cost considerations that can discourage small businesses from joining or can drive them out of online marketplaces. These include costs related to marketing and logistics (see Liu et al. 2021) and service commissions that platforms charge (Karr, Loh, and Wirjo 2020). On the gender front, there are obstacles to the successful adoption of digital solutions for women-owned enterprises and to harnessing the enabling potential of female entrepreneurship. These include inadequate entrepreneurial skills (Sihotang et al. 2020; Koellinger et al. 2013) and traditional constraints related to the household's division of labor (Yu and Cui 2019). The earnings gap has also been observed, with women sellers on eBay receiving about 80% of what men sellers get for selling identical products (Kricheli-Katz and Regev 2016).

Social media platforms, such as Facebook and Twitter, are built on the idea of networking. These platforms provide cheaper alternative channels for small businesses to gain visibility in wider markets, create brand awareness, and expand their client base. Moreover, people are familiar with social media tools, making these platforms attractive to novice digital entrepreneurs (International Finance Corporation 2021). Indeed, social media have become powerful tools for creating a robust online presence (Duffy and Pruchniewska 2017) and facilitating trust and confidence in online marketspaces through closer interactions and immediate feedback among customers (Valerio, Lecoq, and Quéré 2019). Thus, enterprises turn to social media for marketing, advertising, and selling. Factors that determine the adoption of social media as a marketing tool include variables in the Technology Acceptance Model, such as compatibility, perceived usefulness, and perceived ease of use (Syaifullah et al. 2021; Chatterjee and Kar 2020).



## Online Marketplaces in the Philippines

In January 2021, the Philippines had 73.91 million internet users (67% of the total population), registering a 21.9% year-on-year growth of active social media users. They spend 10 hours and 56 minutes daily, around 39% of which is spent on social media.<sup>3</sup> With regard to e-commerce, around 38.88 million Filipinos purchase consumer goods via the internet, valued at US\$ 3.55 billion, which shows a growth rate of 42.5% in the total value of the consumer goods.<sup>4</sup> Leading social media platforms among internet users in the Philippines in the third quarter of 2020 include YouTube (97.2%), Facebook (96.8%), Facebook Messenger (92.1%), Instagram (73.4%), Twitter (62.7%), and TikTok (48.8%).<sup>5</sup> Although there are many e-commerce platforms in the Philippines, there are consistent leaders based on website traffic, presence on mobile applications, and social media followers (Bayudan-Dacuycuy 2021). Shopee, Lazada, Zalora, and eBay are among the leading retail platforms in the country based on the number of Facebook followers in the first quarter of 2021. Lazada, Shopee, Zalora, and Melissa Philippines are among the leading platforms used on internet traffic.<sup>6</sup>

Concerning e-commerce, a survey of Filipino online sellers in Lazada in 2020 indicates that women are more likely to use social media platforms. The same study suggests that around 70% of women online sellers are microenterprises. In the context of the pandemic, women's sales performance in electronics and general merchandise dropped, while it increased in fast-moving consumer goods and fashion (International Finance Corporation 2021). Containment measures arising from the ongoing pandemic have exposed the weak capabilities of some enterprises to adopt digital solutions. For example, women-, youth-led, and micro and small enterprises have dedicated fewer resources to innovation (International Trade Centre 2020). A higher percentage of women-led or women-managed enterprises have resorted to one solution or a combination of the following: shut down the business, scale down employment, or secure funding to continue operations (Asian Development Bank 2020).

## Programs and Initiatives Related to Online Marketplaces in the Philippines

Strong infrastructures are needed for online marketplaces to develop and thrive. Foremost of these infrastructures is adopting financial technology that facilitates integrated financial and payment ecosystems. The Bangko Sentral ng Pilipinas (BSP) has crafted its Digital Payments Transformation Roadmap 2020–2023 with digital payment streams, digital finance infrastructure, and digital governance standards as pillars that outline the BSP's initiatives towards greater adoption of digital solutions, further development of infrastructures, and better adoption of global best practices and standards.<sup>7</sup> Thus, several developments in digital payments can be noted. Active e-wallets grew by 62.2% between 2019 and 2020. In addition, digital payments via the PESONet and InstaPay, the state-led electronic fund services, had registered a year-on-year growth rate of 134% and 469.5% in value, respectively. The ecosystem of diverse payment channels, including credit cards, e-wallets, online banking, and over-the-counter payments, facilitated the survival of e-commerce and, thus, the survival of businesses during the pandemic (Bayudan-Dacuycuy 2021). As of April

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<sup>3</sup> Data taken from <https://datareportal.com/reports/digital-2021-philippines>, accessed 8 September 2021.

<sup>4</sup> Data taken from <https://datareportal.com/reports/digital-2021-philippines>, accessed 8 September 2021.

<sup>5</sup> Statista, accessed 8 September 2021 <https://www.statista.com/statistics/1127983/philippines-leading-social-media-platforms/>.

<sup>6</sup> Data taken from <https://iprice.ph/insights/mapofecommerce/en/>, accessed 9 September 2021.

<sup>7</sup> [https://www.bsp.gov.ph/Media\\_And\\_Research/Primers%20Faqs/Digital%20Payments%20Transformation%20Roadmap%20Report.pdf](https://www.bsp.gov.ph/Media_And_Research/Primers%20Faqs/Digital%20Payments%20Transformation%20Roadmap%20Report.pdf), accessed 8 September 2021.

2021, there were 82 PESONet participants, three of which were electronic money issuers (DCPay, G-Xchange, and PayMaya) that facilitate business-to-business (B2B) and consumer-to-business (C2B) fund transfers.

Financial inclusion, an essential aspect of e-commerce, has long been a challenge since only 28.6% of adults (aged at least 15 years old) had formal financial accounts in 2019 (Bangko Sentral ng Pilipinas 2019). By gender, 32.9% of female adults had formal financial accounts, or around 8.7 percentage points higher than male adults. Cognizant of account ownership as a basic requirement of digital financial transactions, the BSP approved five digital banks' operations (UNObank, UnionDigital Bank, GoTyme, Overseas Filipino Bank, and Tonik Bank) in 2021.

Digital financing platforms are also slowly gaining traction in the financial ecosystem. Based on the BSP's financial inclusion dashboard in the third quarter of 2020, crowdlending, crowd investing, and crowdfunding transaction values grew by 14%, 28%, and 8% from 2019 to 2020, respectively. In addition, the Department of ICT (DICT) has programs, including the digitaljobsPH program to help the countryside take advantage of ICT-enabled jobs through training and free Wi-Fi to provide connectivity in public spaces. In 2020, the digitaljobsPH program offered online training to provide learning opportunities during the lockdown and to help Filipinos gain the competencies needed in digital marketplaces (DICT 2021). The online training covers Digital Marketing/e-Commerce, Web Development, Social Media Marketing, and Advertising, Search Engine Marketing and Advertising, Content Writing, Graphic Design, and Virtual Assistance.

### **3. METHODOLOGICAL APPROACH AND DATA SOURCE**

#### **Conceptual Framework**

Online selling is an entrepreneurial activity and can be considered a type of self-employment. Thus, the framework of choice for characterizing participation decisions and earnings outcomes in online marketplaces may be regarded as structurally similar to economic approaches for accounting earnings/income differences among the self-employed. However, in terms of online selling and earnings differentials, only a few studies of quantitative nature have been written. One of the more informative studies, Kricheli-Katz and Regev's (2016) analysis of eBay bid data, indicates that bids for merchandise sold by females were only 80% of the bids tendered to identical products sold by males. Meanwhile, factors to the success of online businesses include government support, networking, risk-taking propensity, reliability, logistics and transportation, product quality, product price, advertising on social media, and staff employees (Phonthanakitithaworn et al. 2019). In addition, the online seller faces many big and small competitors within a particular segment of the goods market.

Despite limited empirical studies that characterize earnings in online selling, the number of empirical papers to analyze self-employment earnings remains robust. Such empirical papers also inform the modeling strategy used in our paper. Among the self-employed, males earn more than females (Willis et al. 2019), while between self-employment and paid employment, the unexplained gender earnings gap is higher in the former (Lechmann and Schnabel 2012). Using German data collected during the pandemic, Graeber, Kritikos, and Seebauer (2021) found that self-employed women were more likely to suffer from income losses than their male counterparts. No such gender gap was evident among paid men and women.

Meanwhile, Levine and Rubinstein (2019) found that incorporated entrepreneurs respond cyclically to business cycles. On the other hand, the unincorporated self-employed respond countercyclically. This result is consistent with the observation in the Philippines that during periods of crisis, people become more enterprising by selling on social media platforms to generate income for survival. Some of the bigger enterprises switched to retail platforms even before the pandemic.

While online selling can be considered an entrepreneurial activity, the selection processes to participate in online marketplaces and the income-generating function are quite different from non-online entrepreneurial activities. First, although online marketplaces or platforms facilitate commercial transactions between buyers and sellers, most of these transactions rely on sophisticated platforms, while others can be done within social media sites. Technology is adopted depending on perceived benefits, usefulness, costs, and risks. For instance, one study in Malaysia focused on the determinants of adopting social media as an online business platform (Nawi et al. 2019; Mason, Narcum, and Mason 2021; Appel et al. 2020). Sulistyaningrum et al. (2021) found that using smartphones has allowed those who stay at home to increase their involvement in small-scale enterprises, highlighting the effects of ICT devices on labor market outcomes. Adoption can be explained by risk and trust (Jadil, Rana, and Dwivedi 2022) and attitudes due to a lack of knowledge (Li et al. 2011).

Second, the online seller faces many big and small competitors within a particular segment of the goods market. A prospective market participant would then evaluate the opportunities and challenges of participating on a platform and the ease of compliance to the platform's requirements, including subscriptions, listing, and revenue sharing agreements. This forces the online seller to adopt strategies beyond locational aspects, as the online marketplace is unconstrained by geography, time, and space.

Third, while largely unregulated, online selling is where government interventions may achieve favorable outcomes by facilitating investments in ICT infrastructures. For example, ICT developments in Africa increase women's participation rates (Ngoa and Song 2021). With the proliferation of content production, taxation is also an emerging development on the fiscal front. Fiscal authorities contend that earnings from online marketplaces and internet-based creative platforms such as YouTube represent taxable income.

Fourth, online marketplaces may require digital skills more than traditional marketplaces. This introduces additional requirements and considerations. The usual requirements in formal labor markets, like educational attainment and training, are not as rigid as those in online marketplaces. The lack of earning opportunities or limited income (negative selection) and technology-related incidents may lead to disengagement from these marketplaces.

## Empirical Strategy

The preceding description of processes and data leads us to a feasible model highlighting skills, risks, perceptions, technological platforms, and community-based characteristics. In the model, income is conditioned on the participation propensity, and participation requires a broad appreciation of costs, benefits, and risks. Individuals decide whether it pays to engage in online selling or not. Consider the decision calculus of an individual deciding to participate as an online seller. Define the following linear process that generates a latent variable  $d_i^*$

$$d_i^* = x_i'\beta + c_i'\gamma + z_i'\delta + \epsilon_i, i = 1, 2, \dots, N \quad (1)$$

where the vectors  $\mathbf{x}$ ,  $\mathbf{c}$ , and  $\mathbf{z}$  refer to personal/individual attributes, variables that pertain to community attributes, and perceptions of benefits and risks, respectively. In the context of the online marketplace, we do not observe  $d_i^*$  directly but it determines the observed outcomes in  $d_i$ .  $d_i$  is dichotomous with a threshold normalized at 0:

$$d_i = \begin{cases} 0, & d_i^* \leq 0 \\ 1, & d_i^* > 0 \end{cases} \quad (2)$$

Assuming that  $\epsilon_i \sim N(0,1)$ , then the conditional probability  $Pr[d_i|x_i, c_i, z_i]$  is specified as  $Pr[d_i|x_i, c_i, z_i] = \Phi(x_i'\beta + c_i'\gamma + z_i'\delta)$ . To identify the parameters up to scale, Cameron and Trivedi (2005) remarked that the following restriction be imposed:  $var(\epsilon) = 1$ .

Participation ensures that the individual has a chance to earn income from online selling, but it does not guarantee high income. An individual whose unobserved attributes are correlated highly with the unobserved attributes of online selling income would find him/herself well-rewarded. We use the following structures to represent the income-generating process  $y_i^*$ .

$$y_i = \begin{cases} -, & d_i^* \leq 0 \\ y_i^*, & d_i^* > 0 \end{cases} \quad (3)$$

The process highlights a data feature that restricts income data to those engaged in online selling. Let the latent process be specified as  $y_i^* = w_i'\beta + \mu_i$ ,  $i = 1, 2, \dots, N_1$  and  $N_1 < N$ . The vector  $\mathbf{w}$  may contain variables found in  $\mathbf{x}$ ,  $\mathbf{c}$ , and  $\mathbf{z}$ . The observed income is conditioned on  $d_i^* > 0$ .  $E[y_i|d_i^* > 0]$ . Following Cameron and Trivedi (2005),  $cov(\mu, \epsilon) \neq 0$ . This means that  $\beta$  is inconsistently estimated if there is dependence between  $\mu_i$  and  $\epsilon_i$ . The assumed relationship is given by  $\mu_i = \sigma_{12}\epsilon_i + \nu_i$ , where  $\epsilon_i$  and  $\nu_i$  are uncorrelated errors. By accounting for the effects of truncation, the conditional mean is specified as follows:

$$E[y_i|w_i, d_i^* > 0] = w_i'\beta + E[\mu_i|\epsilon_i > -(x_i'\beta + c_i'\gamma + z_i'\delta)] \quad (4)$$

Using the dependence between  $\mu_i$  and  $\epsilon_i$ , the final equation becomes

$$E[y_i|w_i, d_i^* > 0] = w_i'\beta + \sigma_{12}\lambda(x_i'\beta + c_i'\gamma + z_i'\delta) \quad (5)$$

where  $\lambda(\cdot)$  is the inverse Mills ratio (IMR). By construction, the IMR accounts for truncation in the distribution of the unobserved errors in the log income equation. Therefore, the income and selection equations are deemed independent, given a statistically insignificant IMR.

## Data and Operationalization

The primary data is the 2019 NICTHS collected by the Department of ICT in partnership with the Philippine Statistical Research Institute. To generate national, regional, and provincial estimates, the Philippines Statistics Authority designed the 2013 Master Sample. The Master Sample comprises 117 domains, divided into 81 provinces, 33 urbanized cities, and three other areas. Each domain is further divided into primary sampling units (PSUs), which can be a whole *barangay*.<sup>8</sup> First, the Master Sample selects PSUs using systematic sampling. Then, in each chosen

<sup>8</sup> This is the basic political unit in the Philippines.

PSU, a sample of households or housing units is randomly selected through systematic sampling.

The NICTHS is the country's first-ever nationally representative survey with modules designed for characterizing digital commercial and noncommercial engagements, including ICT use, digital economy, and technology-enabled incidents. In addition, income from online selling, information on platforms where selling took place, and community-level variables collected at the *barangay* level are also available. These include the availability of electricity supply, the strength of cellphone signal and internet Wi-Fi signal, and telecommunication infrastructures such as the presence of fiber optic cable and telecommunications towers.

Within the Heckman selectivity framework, two component equations are present: the selection and outcome equations. Equation (6) shows the probability model for estimating the likelihood that an individual would opt to become an online seller.

$$Pr(\text{seller}_i) = \mathbf{x}'_i\beta + \mathbf{c}'_i\gamma + \mathbf{z}'_i\delta + \mu_i, i = 1, 2, \dots, N \quad (6)$$

where  $i$  denotes the index for individuals, respectively.  $\Phi(\cdot)$  is the standard normal cumulative density function, which acts as the link function.

**seller** pertains to online selling and is equal to 1 if the online income is positive and 0 otherwise. The reported income in NICTHS is the average over the last 12 months.  $\mathbf{x}$  is the vector of individual characteristics, including an indicator for female sellers, age categories, and college education. In terms of skills, clerical, social, technical, and research skills are also included. Sex and skills indicators are interacted to recognize the differences in skills between gender, a stylized fact found in Sihotang et al. (2020) and Koellinger, Minniti, and Schade (2013). An indicator of access to the internet on a laptop is also included.

$\mathbf{c}$  is the vector of community variables, which included urbanity. The presence of a fast mobile signal (4G LTE/4G+) in the community and fiber optic cable installations are also important in identifying the effects of area-specific policies or developments. While relatively more expensive than DSL-type of connections, fiber-dependent internet is faster, has higher capacity, and is more reliable. This makes fiber optic infrastructures better suited to the needs of online marketplaces.

Finally,  $\mathbf{z}$  is the vector of variables related to the conduct of online selling, which include indicators for habits, awareness of issues and opportunities, platforms used in selling, and products sold. The use of digital payments can capture the respondent's trust in cashless transactions, a requirement for online marketplaces. Thus, based on the respondent's response to the question, "*In the last twelve months, which of the following electronic modes of payment did you use when purchasing goods and services from physical stores (e.g., supermarkets, department stores, restaurants, etc.)?*," a variable is created to represent the use of mobile wallets, ATM/debit/credit cards, or rewards/loyalty cards. This represents digital payment habits. One's awareness of online transactions can also drive participation in online marketplaces. Thus, an awareness of transactions that can be conducted via the internet is included and is equal to 1 if the respondent answered yes to the question "*Are you aware that business/financial transactions could be performed through the Internet?*", 0 otherwise. In addition, awareness of cybersecurity issues is culled from the question "*Have you heard of cybersecurity or data privacy?*" and is equal to 1 if the response is yes and 0 otherwise. The incidence of reporting a cybersecurity incident is also included. The awareness of transactions on the internet is interacted with the incidence of reporting

experienced cybercrimes like SMS scams/text fraud to authorities to account for knowledge of cybersecurity issues and actions against cybersecurity incidents.

The income equation is specified as a linear function.

$$\log(\text{income}_i) = \mathbf{x}'_i\beta + \mathbf{c}'_i\gamma + \mathbf{z}'_i\delta + \mathbf{m}'_i\delta + \epsilon_i = 1, 2, \dots, N \quad (7)$$

Consistent with the framework, there are overlaps between the determinants of selection and income. The outcome variable, income, is culled from the question, “*In the last twelve months and on a monthly average, how much did you earn from selling goods/services online?*.” It is expressed in natural logarithmic form.

Explanatory variables in the income equation are divided into four vectors. Vectors  $\mathbf{x}, \mathbf{c}, \mathbf{z}$  are as previously defined. This time, the vector  $\mathbf{x}$  is augmented by a dummy indicator if the seller considers online selling income as a primary source. Additional inputs/resources are necessary to generate income. Thus, the time spent on the internet is also included. The vector  $\mathbf{m}$  includes variables specific to the conduct of online selling. Income may also depend on online marketplaces where the products are marketed and sold. Therefore, dummy variables to represent selling on their websites, social media, and e-commerce platforms are included. Similarly, sex and selling sites are interacted to account, although partially, for the type of enterprises that female sellers typically engage in when participating in online marketplaces. For example, the International Finance Corporation (2021) finds that most female sellers in one major platform are involved in microenterprises. To account for the products sold in the marketplace, eight categories of products sold online are included.<sup>9</sup>

Central to income-generating outcomes are networks and skills. The nature of information being exchanged and analyzed in online marketplaces necessitates computer literacy. In addition, online content sellers require digital communication and creative skills. Low skills are characteristically more general, but creative skills are more specialized. This may imply that such skills may contribute to higher earnings.

To integrate skills information into the empirical exercise, skills data are created using the factor analysis of 16 computer-related tasks the respondents were asked to have performed in the last three months. The tasks include: communicating; entertainment/gaming; distance learning; copying/pasting; transferring files between a computer and other devices; sending text emails; sending emails with attachments; data encoding; downloading/installing/configuring software; running software programs; computing using the spreadsheet; creating documents using word processing application; creating an electronic presentation using a software; managing/analyzing data using a software; modeling/simulating using a software; and performing research. These tasks are self-reported responses but are not considered perceptions.

Following skills-related research in labor economics that assumes occupational activities contain different skills requirements (see, for example, Poletaev and Robinson (2008); Robinson (2018)), we used factor analysis to reduce the dimensions of the computer-related tasks by estimating latent factors. In factor analysis, tasks are representable by linear functions consisting of factors. Factors are estimated based on how a factor can explain the observed covariance in each activity. One way to determine the admissibility of factor estimates is to verify whether the eigenvalue is

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<sup>9</sup> They include travel/leisure (tickets for entertainment and travel products), entertainment (PC/video games), electronic/software (computer equipment, software, and consumer electronics and accessories), fashion (clothing and cosmetics), financial services (financial products), professional services (creative content and professional services), food, and medicine.

greater than 1. The eigenvalue is associated with the maximum amount of covariance that a factor can account for.

To identify the tasks included in each factor, those with at least 0.5 factor loadings are chosen after rotation.<sup>10</sup> Following the standards in factor analysis and applying these to the 16 computer-related tasks in NICTHS, there are four factors with eigenvalues greater than one. These factors are retained. Tasks associated with factor 1 include copying/pasting, transferring files between a computer and other devices, sending text emails, sending emails with attachments, data encoding, downloading/installing/configuring software, running software programs, computing using the spreadsheet, creating documents using word processing application, creating an electronic presentation using a software, and managing/analyzing data using the software. Tasks that are integral to factor 2 include communicating and entertainment/gaming. Tasks in factor 3 and factor 4 are modeling/simulating using software and performing research, respectively. Each factor represents a specific skill, which can be summarized based on the tasks under each. Given the tasks above, respondents who indicated to have performed tasks in factors 1, 2, 3, and 4 are considered equipped with clerical, social, technical, and research skills, respectively.

### **Descriptive Statistics**

In the NICTHS, 57% are females. Around 38% of the respondents are in the 34–54 age group, and 27% have finished college (Table 1). Less than 10% access the internet on a laptop and have digital payment habits. However, those who are aware of online transactions are on a par with those who are not. While those who are aware of cybersecurity issues are slightly lower than those who are not, those who reported cybersecurity incidents to authorities are eight percentage points higher. In terms of the community variables, urban–rural areas have similar coverage. While only 37% of barangays have fiber optic cables, 68% have a fast mobile signal (4G LTE/4G+). In terms of regional distribution, 15%, 14%, and 12% hail from the National Capital Region, Region 4A (CALABARZON), and Central Luzon, respectively.

Looking into the population of sellers, around 1,328,781, or about 2% of the total population, have indicated involvement in the online marketplace (e.g., those who have positive income from online selling). Female online sellers constitute around 72% of the total population involved in the online marketplace. About 70% of online sellers are found in urban areas (18% male and 52% female). Around 30% in the rural areas are composed of 10% male and 20% female online sellers).

Around 33% access the internet on a laptop and have digital payment habits. However, those who are aware of online transactions are on a par with those who are not. Sellers are aware of online transactions and cybersecurity issues. A large percentage also reported cyber breach-related incidents (around 88%). Very few sellers have technical and research skills. In addition, approximately 68% consider online selling a primary income source. A sizeable percentage sell on social media and are selling fashion merchandise. Around 22% and 20% sell software and food, while less than 5% sell goods and services related to medicines, travel, finance, entertainment, and medicines.

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<sup>10</sup> To rotate factor loadings, we used the default, Varimax method, in Stata.

**Table 1: Summary Statistics of Key Variables**

<b>Main Indicator</b>	<b>All (%)</b>		<b>Sellers Only (%)</b>	
	<b>No</b>	<b>Yes</b>	<b>No</b>	<b>Yes</b>
Seller	98.1	1.9		
<i>Individual characteristics</i>				
Female	42.9	57.1	28.1	71.9
College education	73.1	26.9	39.1	60.9
<i>Age group</i>				
Age group: 10–17-year-olds	87.1	12.9	91.7	8.3
Age group: 18–34-year-olds	72.4	27.6	45.2	54.8
Age group: 34–54-year-olds	62.2	37.8	65.2	34.8
Age group: 55-year-old and above	78.3	21.8	97.9	2.1
<i>Skills</i>				
Clerical skills	98.2	1.8	30.7	69.3
Social skills	49.2	50.8	14.5	85.5
Technical skills	16.4	83.6	93.8	6.2
Research skills	97.7	2.3	97.9	2.1
<i>Habits and awareness of issues and opportunities</i>				
Digital payment habits	93.2	6.8	66.6	33.4
Awareness of cybersecurity issues	56.7	43.4	31.1	68.9
Awareness of transactions on the internet	51.4	48.6	4.6	95.4
Reported a cybersecurity incident to authorities	42.0	58.1	12.5	87.5
<i>Other variables</i>				
Accessing the internet on a laptop	91.8	8.2	66.9	33.1
Primary income source			31.8	68.3
<i>Community characteristics</i>				
Urban	48.0	52.0	30.2	69.8
Barangay has fiber optics	62.6	37.4	46.2	53.8
Barangay has 4G signal	31.9	68.1	15.0	85.1
<i>Variables related to the conduct of online selling</i>				
<i>Platforms used in selling</i>				
Sells on platforms			93.7	6.3
Sells on social media			11.8	88.2
Sells on own site			82.7	17.3
<i>Products sold</i>				
Travel			97.4	2.6
Entertainment			98.9	1.1
Software			78.2	21.8
Fashion			34.5	65.6
Financial products/services			98.6	1.4
Professional services			97.1	2.9
Food			80.3	19.7
Medicines			95.6	4.4
<b>Continuous Variables</b>				
	<b>All (Mean)</b>		<b>Sellers Only (Mean)</b>	
Income			7.8	
Time spent on the internet	3.9		6.6	

Source: Authors' survey tabulation using the 2019 NICTHS.



Regarding the community variables, around 70% of the sellers are in urban areas. Those living in barangays with fiber optic cables are on a par with those without. About 85% are located in barangays with fast mobile signals (4G LTE/4G+). In terms of regional distribution, 38% and 19% hail from CALABARZON and the National Capital Region, respectively.

## 4. RESULTS AND DISCUSSION

### Participation in Online Selling and Earnings

To account for the survey design, the survey-consistent Heckman maximum likelihood-based estimator is used in determining the significance of selectivity in online selling equations.<sup>11</sup> Based on the estimates, the inverse Mills ratio (IMR) is negatively significant, indicating nonrandom selection, and the estimation of earnings on its own will result in selection bias. The negative sign of the IMR implies that not all who participate in online marketplaces have characteristics that contribute to higher earnings. For example, consider participants whose motivation is simply to generate an income while waiting for better opportunities in the local labor market. These individuals may lack commitment and may have a lower investment appetite and tolerance for risk. In turn, these unobserved investment behaviors negatively correlate with earnings.

Estimates are done for two sets of specifications and two samples. Specification 1 controls for urbanity only, and specification two controls for urban and regional characteristics using a full sample and a sample that removes the first, second, and hundredth percentiles. The latter sample attempts to partly address the issue of one-time sellers. The income variable is a monthly average in the last twelve months. Despite this, we acknowledge the potential presence of one-time sellers that may introduce measurement errors. Thus, we remove incomes that are unusually low or high.<sup>12</sup>

The marginal effects of selected variables are presented in Table 2. Complete results, including the subsamples estimates, are reported in the appendix. In terms of participation, females participate in online selling more than men. Respondents with clerical skills who have internet access to portable devices and are aware of transactions that can be performed on the internet are more likely to participate in online selling. Older people, however, are less likely to participate. Digital payment habits, which pertain to the acceptability of the individual to pay for in-store store merchandise and services using electronic methods, affect participation because familiarity with the opportunities can result in better confidence in digital payments. Finally, the presence of a 4G cellphone signal in the barangay positively affects the propensity to sell, highlighting the importance of dependable connectivity in online selling.

On the income front, skills that boost income include social and research skills. The effect of research skills is robust across specifications and samples. Customers demand immediate response and favor sellers who know the product and services sold. Thus, sellers with social and relational skills earn more than those without. In addition, sellers that undertake research are likely to obtain market information that is important in improving their services and product offering, which can help create a market niche and expand their client base. Age, which may be considered a proxy for experience, positively affects income. Technical skills such as modeling, simulation,

<sup>11</sup> We assumed that the error terms  $\mu_i$  and  $\epsilon_i$  are jointly normally distributed.

<sup>12</sup> We acknowledge the anonymous referee for this insight.

rendering, and the educational attainment indicator are not significant determinants of income. Clerical skills are negatively correlated with income, however.

**Table 2: Marginal Effects Based on the Heckman Estimates, Selected Variables**

	Full Sample: With Urban Indicator		Full Sample: With Urban and Regions Indicators	
	Participation: Selling	Outcome: Income	Participation: Selling	Outcome: Income
<b>Individual characteristics</b>				
Female	0.03*** [0.01]	-0.33 [0.24]	0.02*** [0.01]	-0.39 [0.24]
Age group: 55-year-old and above	-0.04*** [0.01]	1.57** [0.72]	-0.04*** [0.01]	1.48** [0.60]
<i>Skills</i>				
Clerical skills	0.02* [0.01]	-0.52** [0.23]	0.01 [0.01]	-0.51** [0.22]
Social skills	-0.01 [0.01]	0.56* [0.31]	-0.01 [0.01]	0.47* [0.26]
Technical skills	0.02 [0.03]	0.04 [0.42]	0 [0.02]	0 [0.36]
Research skills	0.08 [0.05]	0.90** [0.45]	0.09* [0.05]	1.02* [0.53]
<i>Habits and awareness of issues and opportunities</i>				
Digital payment habits	0.04*** [0.01]	0.21 [0.31]	0.04*** [0.01]	0.14 [0.22]
Awareness of cybersecurity issues	-0.03* [0.01]	1.14*** [0.27]	-0.03* [0.01]	1.32*** [0.21]
Reported a cybersecurity incident to authorities	0.02 [0.01]	-0.52* [0.29]	0.02 [0.01]	-0.54 [0.37]
Awareness of transactions on the internet	0.04*** [0.01]	-0.04 [0.55]	0.04*** [0.01]	-0.07 [0.49]
<i>Other variables</i>				
Primary income source		-0.67*** [0.24]		-0.67** [0.26]
<b>Variables related to the conduct of online selling</b>				
<i>Platforms used in selling</i>				
Sells on own site		1.81*** [0.42]		1.55*** [0.39]
Sells on platforms		0.62** [0.28]		0.56** [0.26]
<i>Products sold</i>				
Travel		-1.35* [0.76]		-1.13 [0.73]
Software		-0.41 [0.37]		-0.44* [0.25]
Fashion		-0.66** [0.26]		-0.50** [0.24]
Financial products/services		1.43** [0.60]		1.49*** [0.58]
Food		-0.58* [0.33]		-0.42 [0.31]

Note: \*\*\*/\*\*/\* Significant at the 1%, 5%, and 10% levels, respectively. Figures enclosed in square brackets are standard errors. Specification 1 controls urbanity, while specification 2 controls urbanity and regional characteristics. The number of observations used in the maximum likelihood estimation: 6,633 for the full sample, which translated to a population size= 18,941,820. Marginal effects were computed using Stata 17. Full estimates, including the subsample estimates, can be found in the appendix.

Source: Authors' computation using the 2019 NICTHS.

Critical inputs to online selling include competencies in using devices, awareness of cybersecurity issues, digital payment habits, and the time allocated to internet use. Online selling requires conscious monitoring. It also needs a high degree of responsiveness, requiring familiarity with the resources and tools in the online world. Results indicate that sellers who spend more time on the internet and are aware of cybersecurity issues have higher incomes from online selling. Similar results are observed for sellers accessing the internet on a portable device, although this is not robust across the specifications and samples.

Online selling can be done alongside a more stable form of regular employment, although there are respondents that consider online selling as their primary source of income. Results indicate that the latter earn less relative to the former, which shows the importance of resources and network opportunities available to people with other sources of income.

As for selling channels, platforms and own websites affect income positively, although the latter has a higher impact. Financial products/services positively affect income. This indicates that returns may depend on the informational content and nature of the product being sold. Both expertise and confidence are needed to offer financial products. In contrast, other products such as electronics, clothing, medicine, and food are already subject to intense competition within the online marketplace, with platform owners competing against sellers of related products. Sellers of travel packages earn significantly less.

### **Scenario Analysis: Predicted Earnings**

Income is predicted using benchmark characteristics, which are informed by the profiles above. The seller belongs to the 35–54 age group, has finished college education, lives in an urban area, spends 4 hours per day on the internet, and considers online selling a primary income source. The seller has clerical skills; is aware of cybersecurity/data privacy but not knowledgeable of transactions that can be performed on the internet; does not access the internet on a portable device; sells fashion merchandise on an e-commerce platform and social media; and lives in an area with fiber optic cables and 4G cellphone signal network. In the specification controlling for regions, the seller is assumed to hail from Region 4A. Sellers from this region account for the most significant number of online sellers. Region 4A is close to the National Capital Region and houses various industrial estates and economic zones in the country.

The value of a variable in the benchmark attributes is changed to analyze its effect on the predicted income. It should be emphasized that important variables are not included in the estimation due to data availability. For instance, while the presence of fiber optic cables in the community is accounted for, information on individual subscriptions is not. Leaving out these variables can potentially reduce the estimates for male and female income. Thus, keeping this caveat in mind, the analysis below is always done relative to the benchmark characteristics.

Based on the predicted monthly income shown in Table 3, male sellers possessing the benchmark attributes have income per month higher than their female counterparts by PhP3,000–PhP3,700. The predicted income higher for male than female sellers is valid in all scenarios except where some skills are concerned. For example, female sellers with social skills earn twice, and those with technical skills make 4–7 times as much as male sellers possessing the same skill sets. Possessing research skills has an obvious advantage for male sellers. Male sellers possessing research skills earn

around 7–11 times that of female sellers. In addition, sellers with digital transaction habits make more than those who do not have such.

**Table 3: Predicted Average Monthly (Log) Online Earnings, by Gender**

	Full Sample: With Urban Indicator				Full Sample: With Urban and Regions Indicators			
	Male	SE	Female	SE	Male	SE	Female	SE
Benchmark $\mathcal{J}$	8.57***	[0.71]	7.48***	[0.52]	8.51***	[0.77]	7.62***	[0.59]
Has clerical skills	8.26***	[0.49]	9.14***	[0.42]	8.32***	[0.60]	9.10***	[0.56]
Has technical skills	7.36***	[1.02]	8.82***	[0.61]	7.08***	[1.29]	8.98***	[0.60]
Has research skills	10.93***	[1.26]	8.53***	[0.65]	10.74***	[1.65]	8.86***	[0.80]
Lack of awareness of online transactions	8.55***	[0.86]	7.52***	[0.75]	8.54***	[1.03]	7.71***	[0.84]
Has digital transaction habits	8.81***	[0.65]	7.68***	[0.56]	8.66***	[0.71]	7.74***	[0.56]
Lack of awareness of cybersecurity issues and reporting of incidence	7.40***	[0.56]	6.33***	[0.57]	7.17***	[0.59]	6.32***	[0.95]
Sells on own website and social media	9.26***	[0.86]	8.90***	[0.70]	9.51***	[0.96]	8.61***	[0.77]
Sell: Travel products	7.88***	[1.01]	6.78***	[1.06]	7.88***	[0.99]	6.99***	[1.00]
Sell: Entertainment	9.68***	[0.86]	8.59***	[1.02]	8.86***	[0.95]	7.97***	[0.89]
Sell: Software	8.82***	[0.86]	7.73***	[0.66]	8.58***	[0.86]	7.69***	[0.63]
Sell: Financial products	10.67***	[0.88]	9.57***	[0.91]	10.50***	[1.02]	9.62***	[0.96]
Sell: Professional services	8.71***	[0.84]	7.62***	[0.66]	8.78***	[0.87]	7.90***	[0.66]
Sell: Food	8.65***	[0.71]	7.55***	[0.58]	8.59***	[0.75]	7.71***	[0.57]
Sell: Medicines	9.43***	[0.77]	8.34***	[0.74]	9.56***	[1.06]	8.67***	[0.98]
Barangay has no fiber optic cable and high CP signal	8.09***	[0.69]	7.02***	[0.54]	8.20***	[0.83]	7.33***	[0.62]

  

	Full Sample: With Urban Indicator				Full Sample: With Urban and Regions Indicators			
	Male	SE	Female	SE	Male	SE	Female	SE
Benchmark $\mathcal{J}$	8.88***	[0.62]	8.15***	[0.48]	9.00***	[0.67]	8.45***	[0.50]
Has social skills	8.46***	[0.55]	8.99***	[0.40]	8.54***	[0.53]	9.22***	[0.44]
Has technical skills	7.98***	[1.15]	9.69***	[0.59]	7.87***	[1.26]	9.85***	[0.49]
Has research skills	11.20***	[1.22]	8.89***	[0.70]	11.56***	[1.44]	9.43***	[0.76]
Lack of awareness of online transactions	8.75***	[0.78]	8.05***	[0.66]	9.00***	[0.84]	8.48***	[0.64]
Has digital transaction habits	9.21***	[0.61]	8.46***	[0.51]	9.20***	[0.62]	8.63***	[0.48]
Lack of awareness of cybersecurity issues and reporting of incidence	7.56***	[0.53]	6.84***	[0.49]	7.39***	[0.56]	6.85***	[0.84]
Sells on own website and social media	9.32***	[0.87]	9.29***	[0.66]	9.77***	[0.86]	9.17***	[0.70]
Sell: Travel products	7.78***	[0.84]	7.05***	[0.86]	7.85***	[0.83]	7.30***	[0.84]
Sell: Entertainment	10.10***	[0.83]	9.37***	[0.95]	9.57***	[0.84]	9.02***	[0.83]
Sell: Software	8.88***	[0.71]	8.15***	[0.59]	8.85***	[0.74]	8.30***	[0.56]
Sell: Financial products	10.56***	[0.83]	9.83***	[0.90]	10.53***	[0.92]	9.98***	[0.89]
Sell: Professional services	9.48***	[0.73]	8.74***	[0.58]	9.66***	[0.76]	9.11***	[0.57]
Sell: Food	8.82***	[0.62]	8.08***	[0.52]	8.84***	[0.66]	8.29***	[0.50]
Sell: Medicines	9.87***	[0.73]	9.13***	[0.72]	10.13***	[0.98]	9.58***	[0.88]
Barangay has no fiber optic cable and high CP signal	7.88***	[0.57]	7.15***	[0.53]	8.27***	[0.69]	7.72***	[0.55]

Note: \*\*\*Significant at the 1% level. Figures in [ ] are standard errors [SE]. Benchmark attributes $\mathcal{J}$ : The seller belongs to the 35–54 age group, has finished college education, lives in an urban area, spends 4 hours per day on the internet, and considers online selling a primary income source. The seller has clerical skills, is aware of cybersecurity/data privacy but not knowledgeable of transactions that can be performed on the internet, does not access the internet on a portable device, sells fashion merchandise on an e-commerce platform and social media, and lives in an area with fiber optic cables and 4G cellphone signal network. In the specification controlling for regions, the seller is assumed to hail from Region 4A.

Source: Authors' computation using the 2019 NICTHS.

Selling on own website-social media has a higher effect on income than selling on e-commerce platforms-social media channels. This potentially reflects the costs associated with joining a platform and the expected intensity of competition that sellers would be subjected to, an outcome consistent with the game-theoretic predictions of Ryan, Sun, and Zhao (2012). In this environment, the firm that operates the online marketplace may directly compete with the seller, who is also expected to enter into

revenue-sharing agreements or pay listing fees. This implies that channels other than platforms can be explored, especially by owners of small enterprises who may find joining platforms challenging or costly. This is also a channel that novice online sellers can use to gain visibility and familiarize themselves with the conduct and operation of an online marketplace. A self-operated website, alongside the more popular social media, can help online sellers build a client base that they can bring with them should they join the more organized e-commerce platforms.

Sellers of financial products/services earn more than those who offer other goods/services. They earn 14–18 times as much as those selling travel-related products, 2–7 as much as those selling professional services or foods, and 5–7 times as much as those selling software products. Meanwhile, the sellers' lack of awareness of online transactions results in a lower monthly income. A similar pattern is observed when sellers are unaware of cybersecurity issues or have not reported cybercrimes to authorities.

Relative to the benchmark case, the absence of infrastructure for connectivity that facilitates more stable transactions in online marketplaces results in lower male and female monthly online income (1–2 two times lower than those with such infrastructures).

## 5. FURTHER ISSUES

The preceding analyses focused on the empirical characterization of income and selection (sell or not sell) mechanism within the Heckman selectivity framework. To reiterate an important result, there is evidence of a negative selection, indicating that individuals with a high propensity to participate in online marketplaces may have unobserved attributes that lower their income. However, an interesting question from the preceding discussion pertains to the potential heterogeneity that may arise from the seller type (i.e., online selling being a primary or nonprimary source of income). Given the nature of income data on the NICTHS, the observed income and predicted densities may be informative to highlight the nature of heterogeneity if it exists.

To examine the heterogeneity issue, we appeal to the nonparametric literature and use a consistent test that uses nonparametric kernel methods. Specifically, we use Li, Massoumi, and Racine's (2009) consistent test to validate the equality of the distributions of online selling income by seller type. This kernel density-based test can account for mixed-data structures and requires bootstrapping methods to approximate the null distribution of the test statistic. Briefly, let the density of income of online sellers be denoted by  $f_y$ . Let  $f_{y|p}$  and  $f_{y|np}$  be the distributions of income of those who consider online selling a primary source of income and those who do not, respectively. The following hypotheses are specified.

$$H_0: f_{y|p} = f_{y|np}$$

$$H_A: f_{y|p} \neq f_{y|np}$$

We use the test to compare  $f_{y|p}$  and  $f_{y|np}$  with  $f_y$ . We associate the null hypothesis (i.e., densities are similar) with the idea that when incomes for both types of sellers are drawn from the same population, the densities should be statistically equal. A rejection of the null hypothesis may be associated with heterogeneity,<sup>13</sup> indicating that the proper approach may require subsample analysis instead. The test is bootstrap-based, and we chose 399 replications to approximate the null distribution of the test statistic. Based on Table 4, the densities of income by seller type are equal. Thus, heterogeneity may not be a potential issue in the data on hand when unconditionally characterizing differences in the income distributions between two seller types.

**Table 4: Log Income Density Comparisons**

Densities Compared	Test Statistic	p-value
$f_{y np}$ vs $f_y$	66.37	0.38
$f_{y p}$ vs $f_y$	11.07	0.99
$f_{y p}$ vs $f_{y np}$	45.70	0.11

To further investigate the heterogeneity arising from the seller type, estimates that account for different factors are more informative. Thus, we run quantile regressions to investigate the effects of different factors on the conditional quantiles of income.<sup>14</sup> Quantile regression models are more robust to outliers compared with least squares models. They are useful for evaluating distributional relationships among variables and, more importantly, allow us to model the conditional quantile of the dependent variable given covariates. We test the null hypothesis that differences in parameter estimates associated with seller type are the same across quantiles. Non-rejection of the null hypothesis reinforces the unconditional results of the kernel densities.

Table 5 summarizes test results for a select group of variables. Results show the equality of effects of seller type at low- and high-income quantiles. In terms of products sold, results indicate limited statistical evidence supporting claims of heterogeneous effects across income quantiles. However, the effects of clerical and research skills differ at low- and high-income quantiles. Those who are more skilled than others are likely to find resources, information, and tools necessary for a successful engagement in online marketplaces. Similarly, differences in the effects of selling sites, such as social media and e-commerce, are also evident. These factors warrant further analysis, which we relegate to future research since initial estimations using subsamples based on skills and selling sites have resulted in convergence issues.

<sup>13</sup> We could test this hypothesis using a conventional parametric test in which the mean of income given to specific groups is the statistic of interest. While valued for its simplicity, results may not be robust given that the mean is just a measure of location, unable to account for the distributional features of the conditional distribution.

<sup>14</sup> Using these samples, Heckman estimation is performed, with the primary indicator as the selection variable. Results, available upon request, indicate that the IMR is no longer statistically significant. Thus, OLS can be used as estimators.

**Table 5: Tests for Statistical Difference between Quantiles: Selected Variables**

	Full Sample		Subsample	
	10th vs. 50th	10th vs. 90th	10th vs. 50th	10th vs. 90th
Primary income source	0.5968	0.397	0.513	0.860
<b>Skills</b>				
Clerical skills	0.133	0.008	0.17	0.011
Social skills	0.258	0.132	0.416	0.773
Technical skills	0.116	0.207	0.602	0.557
Research skills	0.078	0.113	0.023	0.001
<b>Selling sites</b>				
Sells on own site	0.501	0.569	0.646	0.828
Sells on social media	0.008	0.157	0.490	0.901
Sells on platforms	0.097	0.547	0.081	0.282
<b>Products sold</b>				
Travel	0.099	0.486	0.337	0.997
Entertainment	0.265	0.191	0.837	0.547
Software	0.270	0.447	0.725	0.778
Fashion	0.446	0.311	0.956	0.981
Financial products/services	0.753	0.616	0.867	0.752
Professional services	0.730	0.669	0.596	0.158
Food	0.189	0.078	0.827	0.296
Medicines	0.632	0.599	0.661	0.749

Note: p-values have been rounded off to the nearest thousandths.

## 6. WAYS FORWARD

Using the first-ever nationally representative data set in the Philippines that collects information on ICT use and the digital economy, our research analyzes the participation of men and women in online marketplaces and their incomes. We use the Heckman estimator to recognize the potential bias arising from unobservable attributes that make people self-select into online marketplaces. Our paper remains true to the gender and development approach by analyzing outcomes for both men and women and providing recommendations that will benefit them.

Our paper finds that male sellers earn more than women sellers in all scenarios except when sellers possess clerical, social, or technical skills. Male sellers with research skills make substantially more than female sellers with the same skill set. We also find that awareness of transactions that can be conducted on the internet and of cybersecurity issues have impacts on income. Infrastructure that facilitates better and more stable connection, selling financial products, and selling on own website-social media channels result in higher earnings.

Given that women sellers earn less than men sellers in most scenarios, more can be done to help them harness the opportunities in online marketplaces. Online marketplaces generate a large amount of information that needs to be processed, analyzed, and translated into feasible strategies. The type of skill matters, as indicated by the greater earnings when possessing research and social skills. Online selling needs soft skills, which are essential when dealing with clients' queries and feedback. These illustrate the similarity of online marketplaces to job markets where a combination of soft and hard skills is required. Thus, skills development strategies

should emphasize the formation of soft and hard skills alongside digital transformation initiatives.

It should be emphasized, however, that skills matter whether one is selling online or in traditional marketplaces, and most of the skills and competencies are acquired in schools. Students are exposed to pedagogical approaches requiring computers, learning courses in technological management and entrepreneurship, and conducting research. Research is now included as part of the K-12 curricula, but a more deliberate shift should be made to emphasize the importance of internet-based research. For instance, browsing on *similarweb.com*, an e-commerce intelligence site, requires research skills or cognitive abilities to discern the right information that online sellers could use to properly scan the business environment, refine strategies, and understand the behavioral parameters of shoppers, to name a few. Thus, best practices in learning should be seen as an integral part of strategies to encourage participation in online marketplaces. A proactive stance on curricula development is needed to enhance learning among women learners. This entails the integration of gendered perspectives in the modules and courses, one that brings awareness of the realities that men and women face in digital marketplaces. These efforts will enhance the learners' sensitivity to gendered expectations and prospects in the marketplaces, which will help shape their efforts towards achieving their goals in such spaces.

Selling on their websites alongside initiatives to make products/services visible on social media yields earnings higher than earnings from the platform and social media channels. This is potentially due to the service fees that platforms charge. Thus, training programs in creating brand awareness and visibility through social media marketing and advertising can help increase the competencies needed to thrive in digital marketplaces. This can help women online sellers the most, especially novice sellers and those involved in microenterprises.

Enriching the information set of existing and potential participants is also vital. The government should ensure that the correct information reaches participants to make informed choices. The presence of negative selection is a case in point. For example, some participants enter the online marketplace as sellers but may not have the ability to realize higher incomes. This is where initiatives on financial literacy and practical courses on digital entrepreneurship and business strategy may be helpful. To enhance women's access to State-led training and programs, the active participation of women's associations and groups in information dissemination is essential. Their active partnerships with key government agencies can help cascade reliable and useful information and provide additional professional and personal support. Related to information would be initiatives on data collection that differentiate digital entrepreneurs from the self-employed. Doing so may solve the observed negative selection, which will aid policymakers in crafting strategies that cater to the financial interests and capabilities of digital entrepreneurs and the self-employed.

Improving the internet speed using fiber technology will encourage participation in online marketplaces. In addition, prioritizing cybersecurity arrangements will promote trust in online spaces. Currently, sellers are subjected to fraudulent practices in the form of fake bookings and fake proof of payments, and buyers, in the form of defective products and false advertising. Indeed, 44% of Filipinos had been targeted by digital fraud (TransUnion 2021). Strengthening cybersecurity and exacting substantial penalties on fraudulent behavior will help enhance trust in online marketplaces. In an advisory issued by the Philippines' Office of Cybercrime at the Department of Justice, three existing laws protect consumer interests against fraudulent practices. These are Republic Act 10175 or the Cybercrime Prevention Act of 2012, Republic Act 7394 or the Consumer Act of the Philippines, and RA 8792 or Electronic Commerce Act of



2000. In this advisory, legal provisions on credentials, payment transparency, and data privacy have been reiterated.<sup>15</sup> But with rapid technological advancements in ICT, regulatory agencies should remain vigilant, given the emergence of more sophisticated fraudulent schemes and practices. Groups and associations can also help the government ensure these schemes are known to a broader audience of men and women entrepreneurs.

At this juncture, the limitations of the paper cannot be overemphasized. While the kernel densities and tests of equality of parameters indicate that the seller type (based on whether online income is a primary or nonprimary source) is not a potential source of heterogeneity, skills and selling sites should be further investigated. Measurement errors can also contribute to estimation bias. For example, the variable of interest in online selling is rigidly defined given the missing information on the frequency of sales. Skills data are also measured through the latent information embedded in the task data. These provide important directions for future data collection. More questions should be added to future data collection to identify motivations, circumstances, income from non-online selling, and other attributes that would identify why some online sellers would opt to declare online selling a primary source of income. Certainly, such information is deemed important to policymakers to map meaningful interventions for struggling sellers who see online selling as a path toward economic success.

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<sup>15</sup> [https://www.doj.gov.ph/files/ADVISORY%20ON%20ONLINE%20SHOPPING%20FRAUD\(1\).pdf](https://www.doj.gov.ph/files/ADVISORY%20ON%20ONLINE%20SHOPPING%20FRAUD(1).pdf).

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APPENDIX

Table 1A: Marginal Effects of Variables Based on the Heckman Estimates

	Full Sample: With Urban Indicators		Full Sample: With Urban and Region Indicators		Subsample: With Urban Indicators		Subsample Sample: With Urban and Region Indicators	
	Participation: Selling	Outcome: Income	Participation: Selling	Outcome: Income	Participation: Selling	Outcome: Income	Participation: Selling	Outcome: Income
<b>Individual characteristics</b>								
Female	0.03*** [0.01]	-0.33 [0.24]	0.02*** [0.01]	-0.39 [0.24]	0.02*** [0.01]	[0.01]	0.02*** [0.01]	-0.53** [0.23]
College education	0 [0.01]	0.26 [0.28]	0 [0.01]	0.22 [0.31]	0 [0.01]	0.23 [0.25]	0 [0.01]	0.27 [0.21]
Office skills	0.02* [0.01]	-0.52** [0.23]	0.01 [0.01]	-0.51** [0.22]	0.01 [0.01]	-0.35* [0.21]	0.01 [0.01]	-0.35* [0.19]
<b>Age group</b>								
Age group: 18–34-year-olds	0.02* [0.01]	1.04*** [0.33]	0.02 [0.01]	1.18*** [0.36]	0.02 [0.01]	0.87*** [0.34]	0.02 [0.01]	1.06*** [0.34]
Age group: 34–54-year-olds	0.01 [0.01]	1.46*** [0.36]	0.01 [0.01]	1.55*** [0.34]	0.02 [0.01]	1.22*** [0.34]	0.01 [0.01]	1.37*** [0.31]
Age group: 55-year-old and above	-0.04*** [0.01]	1.57** [0.72]	-0.04*** [0.01]	1.48** [0.60]	-0.04*** [0.01]	1.50** [0.61]	-0.04*** [0.01]	1.53*** [0.54]
<b>Skills</b>								
Clerical skills	0.02* [0.01]	-0.52** [0.23]	0.01 [0.01]	-0.51** [0.22]	0.01 [0.01]	-0.35* [0.21]	0.01 [0.01]	-0.35* [0.19]
Social skills	-0.01 [0.01]	0.56* [0.31]	-0.01 [0.01]	0.47* [0.26]	0.01 [0.01]	0.13 [0.26]	0.01 [0.01]	0.07 [0.18]
Technical skills	0.02 [0.03]	0.04 [0.42]	0 [0.02]	0 [0.36]	0.02 [0.03]	0.47 [0.41]	0.01 [0.02]	0.32 [0.34]
Research skills	0.08 [0.05]	0.90** [0.45]	0.09* [0.05]	1.02* [0.53]	0.07 [0.05]	0.81* [0.44]	0.08 [0.05]	1.07** [0.53]
<b>Habits and awareness of issues and opportunities</b>								
Digital payment habits	0.04*** [0.01]	0.21 [0.31]	0.04*** [0.01]	0.14 [0.22]	0.04*** [0.01]	0.31 [0.26]	0.04*** [0.01]	0.19 [0.19]
Awareness of cybersecurity issues	-0.03* [0.01]	1.14*** [0.27]	-0.03* [0.01]	1.32*** [0.21]	-0.02 [0.01]	0.86*** [0.26]	-0.02 [0.01]	1.07*** [0.20]
Awareness of transactions on the Internet	0.04*** [0.01]	-0.04 [0.55]	0.04*** [0.01]	-0.07 [0.49]	0.04*** [0.01]	0.08 [0.48]	0.04*** [0.01]	-0.03 [0.38]
Reported a cybersecurity incident to authorities	0.02 [0.01]	-0.52* [0.29]	0.02 [0.01]	-0.52* [0.37]	0.01 [0.01]	-0.50* [0.26]	0.01 [0.01]	-0.44 [0.38]
<b>Other variables</b>								
Time spent on the internet	0.08*** [0.02]	0.08*** [0.02]	0.08*** [0.02]	0.08*** [0.02]	0.08*** [0.02]	0.05** [0.02]	0.08*** [0.02]	0.06*** [0.02]
Accessing the internet on a laptop	0.01 [0.01]	0.21 [0.14]	0.01* [0.01]	0.23* [0.13]	0.01 [0.01]	0.16 [0.13]	0.01 [0.01]	0.17 [0.11]
Primary income source	-0.67*** [0.24]	-0.67*** [0.24]	-0.67*** [0.24]	-0.67*** [0.26]	-0.67*** [0.26]	-0.55** [0.25]	-0.67*** [0.25]	-0.52* [0.28]

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Table 1A continued

	Full Sample: With Urban Indicators		Full Sample: With Urban and Region indicators		Subsample: With Urban Indicators		Subsample Sample: With Urban and Region Indicators	
	Participation: Selling	Outcome: Income	Participation: Selling	Outcome: Income	Participation: Selling	Outcome: Income	Participation: Selling	Outcome: Income
<b>Variables related to the conduct of online selling</b>								
<i>Platforms used in selling</i>								
Sells on own site	1.81*** [0.42]	1.55*** [0.39]		1.47*** [0.40]		1.28*** [0.36]		
Sells on social media	0.45 [0.35]	0.13 [0.37]		0.39 [0.33]		0.04 [0.36]		
Sells on platforms	0.62** [0.28]	0.56** [0.26]		0.54** [0.26]		0.54** [0.22]		
<i>Products sold</i>								
Travel	-1.35* [0.76]	-1.13 [0.73]		-1.59** [0.68]		-1.43** [0.72]		
Entertainment	0.45 [0.72]	-0.15 [0.56]		0.73 [0.62]		0.29 [0.53]		
Software	-0.41 [0.37]	-0.44* [0.25]		-0.49 [0.34]		-0.43* [0.23]		
Fashion	-0.66** [0.26]	-0.50** [0.24]		-0.49* [0.25]		-0.28 [0.23]		
Financial products/services	1.43** [0.60]	1.49*** [0.58]		1.19** [0.53]		1.25** [0.52]		
Professional services	-0.52 [0.50]	-0.23 [0.47]		0.1 [0.44]		0.38 [0.45]		
Food	-0.58* [0.33]	-0.42 [0.31]		-0.56 [0.36]		-0.44 [0.32]		
Medicines	0.2 [0.41]	0.55 [0.66]		0.49 [0.38]		0.85 [0.61]		
<b>Community variables</b>								
Barangay has fiber optics	0 [0.01]	0 [0.01]	0 [0.01]	0 [0.01]	0 [0.01]	0 [0.01]	0 [0.01]	0.46** [0.21]
Barangay has 4G signal	0.02* [0.01]	0.24 [0.29]	0.02** [0.01]	0.11 [0.23]	0.01 [0.01]	0.01 [0.01]	0.01 [0.01]	0.27 [0.21]
Urban	0.01 [0.01]	-0.25 [0.26]	0 [0.01]	-0.23 [0.26]	0.01 [0.01]	-0.54** [0.23]	0.01 [0.01]	-0.53** [0.23]

Note: \*\*\*Significant at the 1% level. Figures below the estimates are standard errors. Specification 1 controls urbanity, while specification 2 controls urbanity and regional characteristics. The subsample removes the first, second, and hundredth percentiles. The number of observations used in the maximum likelihood estimation: 6,633 for the full sample, which translated to a population size=18,941,820, and 6,639 for the subsample, which translated to a population size=18,863,313 when individual weights were applied. Marginal effects were computed using Stata 17.

Source: Authors' computation using the 2019 NICTHS.