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Can the internet buy working hours of married women in micro and small enterprises? Evidence from Yogyakarta, Indonesia

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ADB Working Paper Series

**CAN THE INTERNET BUY WORKING
HOURS OF MARRIED WOMEN IN
MICRO AND SMALL ENTERPRISES?
EVIDENCE FROM YOGYAKARTA,
INDONESIA**

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Abstract

The development of information and communication technology (ICT) has totally changed, especially in relation to the use of the internet. Smartphones play an important role as media for using the internet. Today, with the rapid development of ICT, almost everyone has a smartphone with good access to the internet. People have started to expand the use of smartphones not only for leisure but also for business. This change in internet usage also affects the labor market significantly. Individuals who prefer to stay at home rather than work outside will try to do some business at home. This business usually generates micro and small enterprises (MSEs). The number of MSEs that are digitalizing their business is increasing significantly. They utilize every single digital tool they can, such as websites, social media, web email, and other online marketplaces. Married women, who typically reduce the time they allocate to work due to their responsibility to take care of their children, can also now make money from home easily. By using micro survey data from our field survey in the city of Yogyakarta and Bantul district in January 2018, this paper investigates the impact of internet access on the working hours of married women who are the owners or managers of MSEs and also the probability of working for them. We employ IV estimates, and use the Telkomsel signal as the instrument variable. From the first stage estimation, it can be seen that the Telkomsel signal is a strong instrument. The findings suggest that internet access has a significant impact on increasing the daily working hours of married women. In addition, we find that married women in urban areas increase their working hours when they obtain internet access more than married women in rural areas.

Keywords: internet, married women, working hours, IV, MSE

JEL Classification: J20, J21, J22

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1. INTRODUCTION

The development of information and communication technology (ICT) has totally changed quickly, especially in relation to the use of the internet. Almost everyone nowadays has a smartphone and easy access to the internet. According to Digital 2019 Reports (2019), Indonesia, with its population of around 268.2 million people and ranking as the fourth most populous country in the world, had 355.5 million mobile subscriptions in January 2019. This means that more than half of Indonesian people had two mobile phones or more. In addition, it is also reported that 150 million people, or around 56% of the population, are active internet and social media users. Today, the internet has become an integral part of human life. The presence of the internet is not only for leisure purposes, such as for communicating and engaging with friends through social media, watching films, or listening to music through YouTube, but the internet is also beneficial for work and for the marketplace in doing business. The internet influences the way in which people work.

The change in internet usage related to work affects the labor market significantly. In addition to helping working people work in dealing with many kinds of jobs, people can also create online markets for selling any kind of goods and services. Especially for those who prefer to stay at home rather than leave the house for work, now they can do their work or business from home while also taking care of their family. The usage of the internet for doing business offers an interesting choice for married women who usually reduce the time they allocate to work due to their responsibility to take care of their children. Now they can work from home, including running an online business. The use of the internet as media that may increase married women's labor force participation has been studied by Dettling (2011). She measured internet usage by focusing on home internet use. She generated a dummy variable equal to 1 if an individual used high-speed internet at home. In 2011, the internet coverage for mobile phones was not as good as now, so people still relied on high-speed internet at home for dealing with work and not mobile phones. Dettling (2011) found that home internet enabled women to combine family tasks and work. Similar to Dettling (2011), another study by Omotoso and Obembe (2016) also investigated whether the use of technology appliances such as washing machines, refrigerators, and gas cookers at home might increase married women's opportunities to work. By using logit estimation, the study found that owning household appliances had a positive and significant impact on female labor force participation. The explanation given was that married women could save more time for other activities when technology facilitated their household work.

Globally, according to an ILO report (2018), the ease of accessing the labor market for women can be reflected by several ILO statistical indicators, namely female labor force participation, unemployment, employment, informal employment, and working poverty. If the women's labor market indicators seem more likely to be good than before, it means there is an increasing number of working women in the market. Yet, countries' development levels (developed countries, developing countries, Asian countries, African countries, Arab countries), the gender gap between female and male unemployment, labor participation, and employment rates are significantly different. In Arabia, southern Asia, and northern Africa, in particular, the female participation is very low due to social and cultural norms and their beliefs. Conversely, in developed countries, the gender gap seems lower; this is because the quality of education and labor skills of women in developed countries are most likely similar to those men. The opportunity to gain access to the labor market is also good.

The gender gap in the global labor force participation rate between females and males remains wide. This is because both of these rates went down at the same time. The ILO (2008) reported that the gender gap in 1997 was about 27.5%, and it slightly decreased to 26.3% in 2008. In the ILO's 2018 report, the gender gap in the global labor force participation rate was the same as in 2008 at 26.5%. If we look at the rates separately, the global female labor participation rate tends to decline. It was 52.9% in 1997, 52.5% in 2008, and even dropped to 48.5% in 2018. Correspondingly, the global male labor force participation rate also has a tendency to decline. In 1997, the rate was 80.4%. It decreased to 78.8% in 2008 and fell to about 75% in 2018. Hence, women are more likely to be unemployed than men. In the past, when ICT was less developed, all household tasks were mostly performed by women (housewives). This was the reason why fewer women, especially married women, went out to work. It was why the female labor force participation rate remained lower than that of males. Yet today, with the world going digital, we experience ICT as being much more developed and modern. It greatly helps married women take care of all tasks at home. It really saves their time, and there may be potential time left for working or doing business.

In Indonesia, similarly to the global situation, there is a huge gap in the labor force participation rate between females and males. According to a Badan Pusat Statistik (2018) report in August 2017 the male labor force participation rate was around 83%, while the female labor force participation rate was only 52% approximately. These labor force participation rates were higher than in the previous year by 0.18% for male and 0.99% for female labor force participation. The low rate of female labor force participation may be affected by the decreasing number of married women who participate in the labor market. They usually quit their work for a while to take care of their children, especially children below five years old. After their children turn school age, they can go back to work. Table 1 shows that most female workers work part-time for less than 35 hours a week and do not want to find an additional job. Over 15% of female workers work less than 24 hours a week. Female workers who work for less than 35 hours are still more numerous than male workers, at nearly 28%. Full-time workers who work for more than 35 hours per week are predominantly male workers, and the percentage of male workers who work for more than 45 hours a week is higher still.

Table 1: Percentage of Working Hours by Gender, 2017

Working Hours (per week)	Male		Female		Total
	Workers	Percentage	Workers	Percentage	
1–14	807,202	43.79%	1,036,027	56.21%	1,843,229
15–24	2,195,360	52.41%	1,993,802	47.59%	4,189,162
25–34	3,359,760	57.70%	2,463,199	42.30%	5,822,959
35–44	12,303,495	64.65%	6,727,459	35.35%	19,030,954
45+	21,819,390	74.34%	7,531,034	25.66%	29,350,424

Source: BPS (2018).

Table 2 shows the percentage of age group of workers by gender. We can see that the percentages of female workers in the first two age group of workers, 15 to 19 and 20 to 24 years old, are higher than other percentages of age group of female workers. If the numbers in the 25- to 29-year-old age group start to decrease, it may be because they are married and have children, and they prefer to reduce the number of hours of work instead of taking care of their family at home. If they start to increase again in the 45- to 49-year-old group, it may be because the responsibility to take care of children is

already shrinking. In contrast, more than half of workers are male in the 15- to 64-year-old age group. Thus, overall, the supply of labor is still dominated by male workers in all age groups.

Table 2: Percentage of Age Group of Workers by Gender, 2017

Age Group	Male		Female		Total
	Employee	Percentage	Employee	Percentage	
15 to 19	1,718,139	58.76%	1,206,079	41.24%	2,924,218
20 to 24	4,906,860	61.97%	3,010,984	38.03%	7,917,844
25 to 29	5,726,285	66.36%	2,902,992	33.64%	8,629,277
30 to 34	6,011,578	68.59%	2,752,660	31.41%	8,764,238
35 to 39	6,189,212	68.93%	2,789,197	31.07%	8,978,409
30 to 44	4,770,494	68.98%	2,144,909	31.02%	6,915,403
45 to 49	4,333,611	69.05%	1,942,299	30.95%	6,275,910
50 to 54	3,338,245	68.42%	1,540,689	31.58%	4,878,934
55 to 59	2,241,431	69.16%	999,350	30.84%	3,240,781
60 to 64	1,781,783	70.47%	746,630	29.53%	2,528,413

Source: BPS (2018).

Table 3: Employment Status by Gender, 2017

Main Employment Status	Percentage (%)	
	Male	Female
Self-employee	46.94	53.06
Own business with temporary unpaid assistant	62.52	37.48
Own business with temporary worker/unpaid assistant	73.08	26.92
Regular employee	58.94	41.06
Casual employee	81.53	18.47
Family worker/unpaid worker	19.78	80.22

Source: BPS (2018).

Table 3 confirms that most female workers predominate in self-employee status at more than 53%. In addition, family worker or unpaid worker status shows that the proportion of female workers reaches more than 80%. This information proves that female workers prefer having a flexible job rather than working fixed office hours. Their role of mother and wife in taking care of the home and children makes them choose this kind of job and status. They can make money while taking care of their children from home.

In general, the share of workers' absorption per sector can be seen in Table 4. The highest absorption of workers is around 50% in the commerce, restaurant, and service sectors. This is followed by the agriculture sector, and then manufacturing industry. This implies that the absorption of labor in Indonesia is starting to shift from the agricultural and industrial sectors to the commerce and service sectors. Moreover, in the development of the digital era, there is an easy way for each person to do business/transactions by using the internet. There are a lot of enterprises (startups) that are being developed by using new technology, the Web, and the internet. Recently, the development of startups has been very fast, and according to the Ministry of Communication and Informatics, based on the latest data from the startup registration site in 2018, Indonesia has 2,079 startups.

Table 4: Share of Workers' Absorption per Sector, 2012–2017

Sector	2012	2014	2017
Agriculture	26.91%	25.41%	22.01%
Manufacturing industry	15.13%	13.97%	15.83%
Construction	7.11%	7.48%	7.47%
Transportation, storage, and communication	3.28%	3.52%	3.61%
Commerce, restaurant, and services	46.69%	48.76%	50.18%
Other	0.87%	0.86%	0.91%

Source: BPS (2018).

The huge development of digitalization in business suggests that this business can reduce the unemployment in Indonesia. People can create their own jobs and not be dependent on jobs from government sectors. Thus, this research tries to evaluate the impact of digitalization on labor participation, especially for married women.

This study uses a case study of several micro and small enterprises in Bantul and Yogyakarta. Bantul is the main region of our survey. As an illustration, the total number of industries established in each municipality in Yogyakarta Province in 2017 can be seen in Table 5. Bantul is the municipality that can hire the highest number of employees. That is why this study observes the conditions of workers from this region, and some observations also carry out from Yogyakarta regions.

Table 5: Number of Industries and Employees in Yogyakarta in 2017

Regency/City	Industry Establishments	Employees
Kulon Progo	25,483	72,449
Bantul	21,402	98,695
Gunung Kidul	22,202	84,059
Sleman	18,056	62,876
Yogyakarta	4,073	24,588

Source: BPS (2018).

Furthermore, Table 6 shows that in Yogyakarta Province, the female labor force participation rate was more than 60% on average during the period 2012–2017. This means the rate was higher than the national female labor force participation rate, which was only around 50%.

Table 6: Labor Force Participation Rate by Gender in Yogyakarta, 2012–2017

Year	Male	Female
2012	74.6%	60.34%
2014	77.18%	61.73%
2017	80.72%	62.69%

Source: BPS (2018).

As we can see from the previous discussion, the women's labor force participation rate is still below that of men. This inequality is because there is still an opinion regarding the marginalization of women between professional tasks and domestic tasks, especially for married women. This stereotyping of women may affect women's participation in the labor market. For married women, domestic responsibilities are

equally as important as professional responsibilities. As a consequence of married women's responsibilities, it may be very important to discuss decisions regarding working with their spouses. The informal sector is usually preferable for married women to the formal sector since in the informal sector the time allocated for work is more flexible. The development of ICT is really helpful for women in developing business from home. They can control their business by utilizing the development of ICT.

2. WORKLOAD AND WOMEN'S WELL-BEING

Women's decision to participate in the labor market has the consequence of increasing their workload (domestic and professional workloads). In the last few decades, there have been increasing levels of women's participation in paid work along with improved access to the labor market for them. Given that women have been playing a dominant role in domestic work, the implications of increasing their time allocated to paid work are reduced total time available for domestic work and decreased leisure time. The findings of some empirical studies (Bianchi et al. 2000; Goñi-Legaz et al. 2010; Sayer 2005) revealed that the time-wise upward trend in the proportion of working women is followed by increased participation of men in domestic work, thereby indicating the reallocation of the domestic workload from women (wives) to men (husbands). This is confirmed by Álvarez and Miles (2006), who found that within a household, the wife's participation in paid work is positively correlated with the husband's greater contribution to domestic work. However, this workload reallocation has yet to be done in a balanced manner. This is reflected by the growing trend in men's domestic work hours, which are considerably lower than the upward trend in women's paid working time (Goñi-Legaz et al. 2010). In addition, "core" domestic duties continue to be predominantly performed by women, and their average domestic work hours remain greater than those of men, although women also participate in paid work (Bianchi et al. 2000; Sayer 2005). By assuming that the required total hours of domestic work remain unchanged, apparently the obvious implication is an increase in the total workload for women.

Other studies also found that the effects of changes in the time allocation for paid work on that for domestic work are nonsymmetrical for women and men. In general, the amount of time allocated for paid work is inversely proportional to the time allocation for domestic work, but this correlation is weaker for women (Foster and Stratton 2018; van der Lippe et al. 2018). Also, the magnitude of this correlation becomes weaker in households with low levels of educational attainment. Furthermore, if men from households with low educational attainment stop participating in paid work (become unemployed), apparently their domestic work hours decrease and are compensated for by an increase in women's domestic working time instead (Foster and Stratton 2018).

The time allocation for domestic work and paid work is also affected by other factors relating to the spouse's bargaining power as well as the nature and type of the paid work itself. In essence, the variables that improve bargaining power will be positively associated with a reduced time allocation for domestic work. This is reflected, for example, by a research finding indicating that the time allocated for domestic work will be on a par between women and men if their income differences (Goñi-Legaz et al. 2010) and differences in the ownership of personal assets (Simulja et al. 2014) are more subtle. In addition, flexible types of work (not limited to certain work hours) increase the opportunity for individuals to take part in domestic work (Goñi-Legaz et al. 2010).

Although the above-mentioned factors play a role in the time allocation for domestic work, gender inequality in such time allocation is, in fact, still poorly explained by the existing data. The insensitivity of women's domestic work hours towards their paid work hours indicates the existence of sociological exogenous factors because of which women tend to be burdened with domestic work. The presence of structural identities, social norms, and attitudes towards gender roles in society plays a significant role in such domestic work inequality (Álvarez and Miles 2006). This is in line with a finding that revealed that households with more likelihood of being influenced by traditional norms, such as less educated older couples, have higher inequality in terms of the time allocation for domestic work. At the macro level, countries with more egalitarian gender norms tend to have lower inequality in terms of the total number of work hours (paid work and domestic work) between women and men (Campaña, Giménez-Nadal, and Molina 2018).

Gender inequality in domestic work, which has an impact on women's high total workload, has implications for the well-being of women. This high total workload generally has an impact on women's mental health (Liu, MacPhail, and Dong 2018; Phipps, Burton, and Osberg 2001), particularly relating to stress. For working married women with children, the increased workload in paid work will not only lead to stress but also reduce job satisfaction. This is because when the workload is high, the realization of workload becomes higher than the workload expectations (Boyles and Shibata 2009). Meanwhile, increased domestic workload for women has different effects on the levels of stress, with the greatest effects arising from the work related to daily housekeeping and caring for the elderly (MacDonald, Phipps, and Lethbridge 2005). Given that the highest total workload is experienced by women with low educational attainment, these women become part of the most stress-prone group (Liu, MacPhail, and Dong 2018).

The fact that inequality in the time allocation for domestic work has implications for women's well-being has proved that men's involvement in domestic work becomes essential. As well as reducing women's total workload, men's involvement in domestic work also has other positive effects. The higher men's involvement in domestic work, the greater women's satisfaction with the domestic work distribution (Foster and Stratton 2019). Men's involvement in domestic work and in caring for children also improves marital stability, regardless of whether the women work or not (Sigle-Rushton 2010). However, this increasing involvement is inadequate if there are no changes in the norms related to gender roles in society. Strict adherence to the role of women in domestic work can lead to men's involvement in domestic work being perceived as violating the norms and can adversely reduce women's satisfaction due to such social pressure (Foster and Stratton 2019).

3. LABOR MARKET AND ICT

The use of technology has led to the opening of new opportunities and development. It allows people to conduct their activities efficiently and effectively, thus saving time for doing more productive activities. For example, the use of technology appliances such as washing machines, gas cookers, and refrigerators saves time for women on home duties, giving them an opportunity to work (Omotoso and Obembe 2016). Coen-Pirani, León, and Lugauer (2010) also examine how household appliances affect married women's labor participation rate and find that such appliances are responsible for promoting 40% of the observed married women's labor force participation rates. However, Oropesa (1993) finds that female employment status affects the purchase of time-saving household appliances, especially microwaves. Nevertheless, the study of

the internet and gadgets is different from other studies as those technologies can also be determinants of leisure (Dettling 2011). Meanwhile, the use of mobile phones, computers, and the internet has been increasing rapidly. Those technologies allow fast storage and transfer of information; hence, people can communicate even across vast distances. Not only have they provided more efficient ways to communicate, but they also open up new working opportunities. Weinberg (2000) finds that the use of computers increases the demand for female labor. Dettling (2016) finds that high-speed broadband connection increases married women's labor force participation by 4.1 percentage points.

Badran (2014) estimated the impact of the use of ICT on the development of women's entrepreneurial spirit in five developing countries, namely Egypt, Jordan, Morocco, Algeria, and Brazil. The use of ICT and gender does not affect the profitability of SMEs. Chowdhury and Wolf (2003) found that the use of ICT actually reduced labor productivity but had a positive impact on export market expansion. The use of ICTs in Arabia increases labor intensity, but the use of ICTs actually reduces labor intensity in Brazil. On the other hand, Martin et al. (2005) found that ICT can influence the development of SMEs owned by women in the UK. Badran (2010) also found increasing women's empowerment and access to women's employment after using ICT. Previous research on the impact of using household appliance technology on women's labor supply has had mixed results. Coen-Pirani, León, and Lugauer (2010), Bianchi et al. (2000), and Greenwood, Seshadri, and Yorukoglu (2005) found a positive impact of the use of household technology on female labor participation. Meanwhile, Cardia (2008), Chowdhury and Wolf (2003), and Omotoso and Obembe (2016) found that there is no significant impact. Omotoso and Obembe (2016) found that only the use of washing machines had a significant effect on female labor, while the use of a refrigerator and gas cooker had no effect.

Coen-Pirani, León, and Lugauer (2010) used microdata in the US in the 1960s and 1970s to examine the relationship between ownership of household appliances and workforce participation among females aged 18–55. The results showed that the use of household appliances in the form of washing machines, refrigerators, and dryers was able to increase the participation of married women in the 1960s. Women's labor participation is classified into three categories, namely employment (ratio of married women who work compared to the total workforce), full-time employment (ratio of married women who work at least 35 hours per week), and year-round employment (ratio of women who worked at least 48 weeks in the previous year). The researcher found an endogeneity of ownership of household appliances, so the study used an instrument variable ratio of single female household ownership of appliances at the state level. The results of the study also prove that white female workforce participation increased by 10%. However, the participation of single female workers did not experience significant changes related to the technology of household appliances. Meanwhile, the participation of married female workers who had three household appliances at the same time (washing machines, refrigerators, and dryers) increased by 17% (Coen-Pirani, León, and Lugauer 2010). The results of the study support the GSY hypothesis proposed by Becker (1965) and Gronau (1977).

Becker (1965) and Gronau (1977) developed a model that describes the relationship between the purchase of household appliance technology and female labor participation, which is called the "GSY hypothesis." Becker (1965) put forward the theory of time allocation, namely the selection of labor supply depending on household production and the labor market. The theory also emphasizes that the choice of individuals to work or relax is a response to an increase in wages. Therefore, the decision of women to work is influenced by three things: relaxing, working at home

(doing domestic or household work), and working in the labor market. This selection can also be influenced by socioeconomic factors, including technological innovations in household appliances (Omotoso and Obembe 2016). The results of research by Bianchi et al. (2000) supports the GSY hypothesis that shows a decrease in time to conduct household tasks for married women who work. Greenwood, Seshadri, and Yorukoglu (2005) stated that the use of household technology led to reducing the time required for married women to do household chores so that it had a positive impact on increasing female labor participation. Technology growth leads to saving time in performing household tasks, but the determination of whether women decide to work or not depends on the substitution elasticity of labor and household market utility functions (Jones et al. 2015).

Cavalcanti and Tavares (2008) use country-level data in the OECD region and show the relationship between household equipment prices and female labor participation. Cardia (2008) uses country-level data to examine the relationship between the use of refrigerators and bathtubs in female labor participation in the United States between 1940 and 1950. The results of Cardia's (2008) study show that the use of household technology has no significant effect on female labor participation, but helps increase the participation of female professional labor in the US. Omotoso and Obembe (2016) examined the impact of ownership of modern household technology, i.e., washing machines, gas cookers, and refrigerators, on female labor participation in developing countries. Researchers estimated parameters of interest from the interaction between dummy variable of washing machines, gas cookers, and refrigerators with ownership of generators. The results of the study found that washing machine ownership had a positive effect on female labor participation. Meanwhile, ownership of gas cookers and refrigerators has no significant effect on female labor participation

4. MSEs AND DIGITALIZATION

Data

We conducted a survey on micro and small enterprises (MSEs) in Yogyakarta Province, especially in the city of Yogyakarta and the district of Bantul, in January 2018. Both regions were randomly chosen based on the number of MSEs, which is higher than in other districts in Yogyakarta Province. Data and information were collected for firm and individual levels. For the firm level, the respondents of MSEs were the owner or manager of the MSEs, while for the individual level, the respondents were the owner and household members of the owner of MSEs. This survey randomly sampled 700 MSEs from the Central Bureau Statistics of Indonesia's MSEs survey of September 2017, and we successfully interviewed 576 various types of business MSEs. From the 576 MSEs, we collected 2,215 family members of the owners/managers from MSEs.

We collected information about the behavior of firms in using information and communication technology (ICT) for their business. This survey observed whether the MSEs used the internet in marketing, selling, and buying their products by using email, websites, mobile banking, social media, or other digital technologies. In addition, for the individual level, we interviewed the members of the households of the owners or managers of MSEs. Individual and household characteristics were gathered, in addition to the main questions related to the digital technology. Information related to labor productivity was also collected. The survey utilized computer-assisted personal interview (CAPI) technology developed by the World Bank. Smartphones equipped with a Telkomsel SIM card were distributed to the enumerators. Telkomsel was chosen

since it is the largest cellular operator in Indonesia currently. The CAPI enables information on Telkomsel signal strengths in each survey area to be collected.

This study limits the number of observations by using information from married women who are owners of MSEs. Married women are classified into two groups: one group with internet access and one without. Hours of work is used as a measure of married women's labor force participation. In addition, we also control for individual characteristics, enterprise characteristics, and the number of BTS towers. Table 7 shows the descriptive statistics of micro survey data. The Telkomsel signal strength is about 4.58 bars on average. The mean hours of work are around 8 hours per day, while the percentage of married women who get internet access is 71.3%. On average, the level of education of married women who are the owners of MSEs is around 11 years, which means, on average, that their education background was senior high school level.

Table 7: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.
Hours of work (per day)	329	8.066	3.500
Internet access (1 = yes)	328	0.713	0.452
Telkomsel signal strength (0 = no signal, 1–5 bars)	329	4.586	0.756
Number of children below 5 years old (children)	329	10.844	14.016
Educ. (years of educ.)	323	11.368	3.734
Age (years)	329	46.273	12.286
Number of refrigerators	329	1.060	0.877
Number of washing machines	329	0.668	0.636
Number of mobile phones	329	3.863	2.254
Length of mobile phone access (hours)	259	3.276	2.306
Wages (million rupiahs per month)	329	2.931	9.428
Home based (1 = production process same residential)	329	0.598	0.490
Business sectors of MSEs (1 = manufacture, 2 = trade, 3 = services)	328	1.908	0.855
Number of BTS towers	329	78.583	81.246

5. EMPIRICAL STRATEGY

Ordinary least squares is used to estimate the effect of internet access on the working hours of married women who are the owners or managers of MSEs. The following estimation model is used to estimate the impact of internet access on female labor force participation:

$$y_i = \beta \text{Internet}_{i,j,k} + X'_{i,j,k} \gamma + \mu_d + \mu_s + \varepsilon_i \quad (1)$$

where y_i is female i labor force participation. It measures by using hours of work in a day for married women who are the owners of micro or small enterprises. The internet is a measure of whether or not the individual has access to and utilizes the internet: internet is equal to 1 if the individual has access and uses the internet, and 0 otherwise. i represents an individual married woman, j represents an enterprise, and k represents a sector of enterprise. The coefficient of interest is β , which measures the impact of internet access on hours of work. Importantly, this model includes a vector of individual controls X'_i ; the vector X_i contains the other explanatory variables that absorb individual i and household characteristic differences in using the internet and

participating in the labor market. Here, we control for the age, education, dummy location (rural or urban), number of kids below five years old, wage, being home based (if the business site is the same place as the household residence), the ownerships of household appliances such as washing machines, refrigerators, and mobile phones, and the length of using a mobile phone. We also control for the number of BTS (base transceiver station) towers in each subdistrict since the strength of the internet depends on the availability of BTS towers. In addition, this model also includes district (Yogyakarta City and Bantul) fixed effects μ_d and business sector (manufacturing, trade, and services) fixed effect μ_s , which are included to ensure the estimate coefficient on the internet is net of any differences across district and business sectors in terms of internet access and participation. Standard errors are clustered at the subdistrict level, since there are multiple MSEs within the same subdistrict as we suspect to be the case.

6. INSTRUMENTAL VARIABLE ESTIMATION

Instrumental variable (IV) estimation is used to deal with endogeneity of the use of the internet and also to correct for selection bias based on unobservable characteristics. In addition, IV estimates the effect of the treatment on those individuals whose behavior is affected by treatment. That is, IV estimation provides an estimate of the causal effect for those individuals who change the treatment status because of the instrument.

Internet may be an endogenous variable—an observable explanatory variable that is correlated with the unobservable error term. The endogeneity of the internet could arise because of reverse causality or simultaneity, spurious correlation, or self-selection. The simultaneity problem is one source where we should worry about the endogeneity problem of the internet since female workers may increase their hours of work in the labor market because they can access the internet, or the probability of accessing the internet may increase because female workers change their hours of work in the labor market, thus they can afford to pay the use of internet costs. In the case of an omitted variable bias problem, utilizing the internet in the labor market may be correlated with an omitted variable such as the ability of female workers that we cannot measure. Self-selection is another cause of endogeneity of internet use. It may be that female workers can access the internet because they live within a good internet network with a good signal strength, while those who live with a poor signal strength cannot get good internet access.

Blundell, Dearden, and Sianesi (2005) said that IV can overcome the OLS bias that results from endogeneity of the explanatory variables. IV corrects for the endogeneity problem by using good instruments. This instrument is correlated with the causal variable of interest, internet, but uncorrelated with any other determinants of the dependent variable. This variable has a clear effect on Internet use in the first-stage of the regression, and the only reason for a relationship between female labor force participation and internet use is from the first stage. According to Angrist and Pischke (2009), good instruments come from a combination of institutional knowledge and ideas about processes determining the variable of interest.

Hence, IV estimates the average treatment effect of the internet among those individuals whose treatment status is influenced by changing an exogenous regressor that satisfies the exclusion restriction. The treatment effect that we estimate is the average treatment effect for those who adjust their treatment status because they react to the instrument. That is, IV estimates the local average treatment effect (LATE) of the impact of internet use on a subset of individuals. Card (2001) suggest that LATE

estimates from IV could exceed OLS estimates, because they estimate average effects for a specific group, whereas OLS estimates, in the absence of omitted variables and measurement error biases, estimate the average effect across everyone. Imbens and Angrist (1994) said that instrumental variables estimated a LATE under very weak conditions. There are two potential weaknesses: IV estimates the effect of a treatment on a generally unidentifiable subpopulation; and the LATE estimate will vary depending on the particular instrumental variables that are used. In the case of our study, the IV estimate is a LATE for those whose Internet use status is affected by the identity of the signal strength where they live.

This study used signal strength as an instrument for internet use. Thus, the instrument variable is good exclusion restrictions, since this variable is highly correlated with the probability of internet access, but there is no reason to believe these would be a correlation with any other variables that encourage female workers to participate in the labor market. Hence, the instrument should be uncorrelated with female hours of work beyond their impact on the likelihood of accessing the internet.

Thus, the model that is used for instrumental variable regression can be written as:

First-stage equation:

$$Internet_i = \beta signal\ strength_i + X_i' \theta + \mu_i \quad (2)$$

Second-stage equation:

$$Female_LFP_i = \alpha \widehat{Internet}_i + \gamma X_i' + BTS_i + \sigma_d + \sigma_s + \varepsilon_i \quad (3)$$

In the first-stage equation, the Internet dummy is the dependent variable. This study used a signal strength as the instrument variable for internet. Moreover, the vector X_i contains the other explanatory variables to capture individual and household characteristics (same control variables as in OLS estimation). We also add district fixed effect and business sector fixed effect, which are used to take the difference out of the district average and business sector average, and we also use cluster-robust standard errors at subdistrict level for taking the difference out the averages for observational MSEs in each subdistrict.

7. RESULTS

Instrumental variable regression is adopted for dealing with the endogeneity problem. We use IV estimation as the main discussion, as Oreopoulos (2006) said that the IV method is often used to evaluate programs because IV can estimate a more consistent treatment effect than OLS. IV estimates should have a valid instrument to confirm whether the individual is treated, but IV does not control for other factors that influence the outcomes of interest. We conducted tests of endogeneity for the internet access variable, and the variable is absolutely endogenous. The probability values of the Wu-Hausman F test are 0.000 without controlling for other factors and 0.043 for the F value in robust regression if controlling for other factors. Since all the probability values are less than 0.05, we reject the null hypothesis that variables are exogenous, therefore IV estimates are better than OLS. Table 8 shows the first-stage estimation for the basis of all IV estimation. The results indicate that the Telkomsel signal is positive and statistically significantly influenced our endogenous variable, internet access. This instrument also passed the test of weak instruments. We reject the null hypothesis of weak instruments. All the P value tests of weak instruments are smaller than 0.01. In

the first model, without controlling for other factors, the P value is 0.0000, while the model controls for other factors that are also statistically significant at 0.001. The probability of using the internet increases by around 8% when the signal is stronger by one bar.

Table 8: First Stage for IV Estimates

Dept Variables: Internet Access	(1)	(2)
Telkomsel_signal	0.152*** (0.005)	0.079*** (0.019)
Control and FE	No	Yes
F stat of endogeneity test	348.675	4.794
F stat of weak instrument	786.202	16.070
Observations	328	256

Note: Cluster standard errors at subdistrict level in parentheses, *** p < 0.01, ** p < 0.05, * p < 0.1. Control variables: age, education, number of kids under five years old, wage, being home based, ownership of household appliances such as washing machines, refrigerators, and mobile phones, and the length of using a mobile phone, number of BTS towers, district fixed effects, and business sector fixed effect.

We present both results of OLS and IV estimates. Hence, the coefficient of OLS estimate only shows the average effect of internet access on working hours, while the IV estimate measures the local average treatment effect (LATE). According to Imbens and Angrist (1994), LATE evaluates the effect of the average treatment effect on those who receive the treatment and make the same adjustment or react to the instrument. Thus IV measures the local average treatment effect (LATE) of internet usage on working hours as a consequence of receiving a good signal from Telkomsel.

Table 9: The Impact of the Internet on Working Hours of Married Women

Variable	OLS	OLS	IV	IV
	(1)	(2)	(3)	(4)
	Working Hours	Working Hours	Working Hours	Working Hours
Internet access	8.038*** (0.366)	1.779*** (0.527)	11.111*** (0.480)	9.687*** (4.179)
Controls and Fixed Effect	No	Yes	No	Yes
Observations	328	256	328	256

Note: Cluster standard errors at subdistrict level in parentheses, *** p < 0.01, ** p < 0.05, * p < 0.1. Control variables: age, education, number of kids under five years old, wage, being home based, ownership of household appliances such as washing machines, refrigerators, and mobile phones, and the length of using a mobile phone, number of BTS towers, district fixed effects, and business sector fixed effect.

Table 9 presents the estimation using ordinary least squares (OLS) and IV estimation. The estimated OLS coefficients (columns 1 and 2) are smaller than the IV coefficients (columns 3 and 4). Without controlling for other factors, OLS suggests that working hours will increase by around eight hours per day for married women who get internet access. If we control for other factors, working hours are predicted to be increased by 1.8 hours per day. On the other hand, for IV estimations, the coefficient seems higher. Without controlling for other factors, married women who are the owners of MSEs and have internet access would like to increase their working hours by around 11 hours, but if we control for other factors, working hours are predicted to be increased by around nine hours per day. These findings are in line with the judgement of Card (2001). Card (2001) suggests that the parameter of IV is higher than OLS, since the IV approximate

average affects only a small and particular group, while the OLS approximate average affects almost everyone, without considering the absence of omitted variables and measurement error bias.

The findings of this study are in line with Dettling (2011). Dettling explained that the result of estimation should be interpreted as LATE, and it cannot be interpreted as the population average. The IV estimates can be larger than the population average effect. Similar to Dettling's study, from the IV estimates we found that the impact of using the internet on hours of work among married women is very large. The explanation of the large impact is that IV measures the LATE. IV estimates the average effect for individuals who received treatment that is influenced by the instrument variable. IV does not measure the impact on individuals who use or who do not use the internet that are not being affected by the instrument. In other words, the instrument does not affect everyone, but only those who always use it (Dettling 2011). Thus, the LATE can be larger than the average effect of the population.

Given that there are many dimensions that create variety among individuals in using the internet, the behavior of individuals regarding internet access may be affected differently. Elderly and poor people who do not use internet services do not care about internet access. Yet, the behavior will be different among young and active individuals who are always attached to the internet. In order to capture the different effect in using the internet on the working hours of married women in MSEs, we estimate separately by area, education, and also by business sectors. Area is projected to be an important factor that affects married women in using the internet. Married women who live in the city of Yogyakarta are predicted to spend more hours working when they have access to the internet than those in Bantul District. In addition, education is expected to influence married women in accessing the internet. The higher the education of married women, the more working hours they may spend if they have internet access. Furthermore, for the business sectoral category, married women who work for manufacturing and trade industries are more likely to work more if they have internet access than those who work for services.

Table 10: The Impact of the Internet on Working Hours of Married Women by Area and Education

Dept. Variables	Area		Education		
	Bantul (rural)	Yogyakarta (urban)	Primary School	Secondary School	University/ College
Hours of Work					
IV Estimation					
Internet Access	7.350*** (2.041)	12.296*** (4.615)	36.322 (68.996)	6.217** (2.561)	3.519 (3.504)
Observation	175	84	17	159	79

Note: Cluster standard errors in parentheses, *** p < 0.01, ** p < 0.05, * p < 0.1. Control variables: age, education, dummy location (rural or urban), number of kids under five years old, wage, ownership of household appliances such as washing machines, refrigerators, and mobile phones, and the length of using a mobile phone, number of BTS towers, and subdistrict fixed effects.

Table 10 shows the impact of the internet on the working hours of married women by area and education. In terms of area, working hours in urban areas are greater than in rural areas when married women have access to the internet. In controlling for other factors, there are around five working hours' differences between the working hours of married women in urban and rural areas when they have internet access, being higher for urban areas. On the other hand, for the impact of the internet on the working hours of married women by education, married women with a secondary school education

background are significant. There is no significant impact for married women with primary school and university/college educational background.

Table 11: The Impact of the Internet on Working Hours of Married Women by Sector

Variables	Manufacturing	Trade	Services
IV Estimation			
Internet Access	9.011** (3.682)	12.789** (6.484)	-9.100 (13.794)
Observations	103	70	83

Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 11 demonstrates the impact of the internet on the working hours of married women by sector. The highest impact is on the trade sector, followed by the manufacturing sector. The impact on the service sector is not statistically significant. The sectoral estimation supports the finding that MSEs utilize internet access in order to promote products and for making online transactions. This activity mostly covers trade sectors. Furthermore, we also use a dummy variable (work) for measuring married women's labor force participation. Work will be equal to 1 if the individual worked for at least an hour for pay or salary or profit last week, or in a short period of time. Table 12 presents the results from two different estimations (OLS and logistic regression). Without controlling for other factors, all the estimations show that internet access affects the working hours of married women significantly. Yet, if we control for other factors, only OLS shows that the result is statistically significant. Overall, the results prove that internet access will increase the probability of married women working.

Table 12: The Impact of the Internet on Work of Married Women

	(1)	(2)	(3)	(4)
Dependent Variable: Work	OLS	OLS	Marginal Effect (Logit)	Marginal Effect (Logit)
Internet Access	0.656*** (0.023)	0.219*** (0.068)	0.151*** (0.0205)	0.089 (0.064)
Control	No	Yes	No	Yes
Observations	326	326	327	327

Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1.

8. CONCLUSION

This research examined the causal impact of internet access on married women's labor force participation. We find that internet access has a significant impact on increasing the working hours of married women per day. Internet access also suggests an increasing probability of married women working. In addition, we find that married women in urban areas increase their working hours more when they have internet access than married women in rural areas.

Evidence from this paper is expected to suggest for policymakers that married women's labor supply is sensitive to ICT progress. The quality of the internet is expected to be improved, which will encourage women to work. By making it possible to do business from home while taking care of the kids, it can create additional family income and thus enhance family welfare. In the long run, we expect married women who are the owners of MSEs to be able to contribute to development and economic growth.

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