

# The Link Between Occupations, Labor Force Participation of Married Women, and Household Technology in Indonesia

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## Abstract

Although the effect differs among occupations, this study indicated that aside from socioeconomic variables, household technology relates to the labor force participation of married women in Indonesia. While the link between household technology and women's labor force participation was analyzed, the research on the impact of household technology on women's occupational choices in the labor market (e.g., white-collar, pink-collar, blue-collar jobs, agricultural) and full-time homemakers was not the focus. Primary data were obtained from the Indonesia Demographic and Health Survey 2017. The data involved a usable sample of 32,559 married women aged 15–49. Using the multinomial logistic model, the study finds evidence that household technology primarily supports married women in pink-collar jobs. Thus, information and communication technology facilitates women in white-collar jobs. However, these elements are negatively linked to women's labor force participation in blue-collar and agriculture. Additionally, the study reveals that the lack of household technology influences inactive married women in the labor market (homemakers).

## Keywords

Female labor force participation; household technology; Indonesia; married women; occupations

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## Introduction

Previous studies revealed that housework plays a massive role in female labor force participation (FLFP) in Asia (Asian Development Bank, 2015). The Sustainable Development Goals Report 2019 indicated that worldwide, women spend three times the time as men in daily unpaid care and domestic work (United Nations, 2019). Inefficient cookstoves, hand washing clothes, water and sanitation issues, and transportation needs increase women's burdens. According to the 2030 Sustainable Development Goals, the burden of housework and low FLFP are critical issues in developing countries since it is part of ongoing national efforts to end poverty (Goal 1), achieve gender equality and empower all women (Goal 5), and promote inclusive and sustainable growth, full and productive employment, and decent work for all (Goal 8). While women do most of the housework and caregiving, they have less time for labor market participation and might choose their occupations according to the above criteria. Therefore, improving the possibilities for women's labor force participation in the channel of the modification of time patterns of the housework is crucial.

The substitution for household production within household technology can facilitate increased time for labor market participation. Following this approach, the literature from developed countries during the technological revolution found that household technology reduced housework time and, as a result, increased the supply of women in the labor market (Bose et al., 2022; Cardia, 2008; Cavalcanti & Tavares, 2008; Greenwood et al., 2005; Vidart, 2021). Developing countries, focusing on the data of the current decade, indicated that the ownership of household appliances (Dueso-Barosso, 2019; Mitschiener & Siy Van, 2018; Omotoso & Obembe, 2016; Tewari & Wang, 2021) or access to electricity (Chhay & Yamazaki, 2021; Grogan & Sadanand, 2013; Tagliapietra et al., 2020) positively affect women employment participation.

Further, recent studies emphasized that the impact of household modernization on women's employment differ within levels of education (Bose et al., 2022; Tewari & Wang, 2021; Vidart, 2021) and employment type between non-agricultural and agricultural (Chhay & Yamazaki, 2021; Dueso-Barosso, 2019; Tagliapietra et al., 2020). Even though Cardia (2008) scrutinized the effects on some job positions in the United States, no recent study investigates household modernization's impact on occupations in a developing country. Household technology might impact the female labor supply in developing countries since women do more manual housework (Dinkelman & Ngai, 2021).

The study finds a necessity to focus on married women's occupations in Indonesia. First, the 1974 Marriage Law determines a wife as the responsible person for the household (Schaner & Das, 2016). Therefore, housework is an essential factor for married women's participation in the labor market in Indonesia. As a result, 40.8% of married women are not in the labor force (Meidika et al., 2019). Second, although women dominate the primary responsibility of household chores in the country, the impact of household technology on married women's labor force participation is underrepresented in Indonesia. Few studies explored the effects of access to the internet on women's employment (Kusumawardhani et al., 2021; Sulistyaningrum et al., 2021; Suwadji, 2020). However, there is an absence of studies investigating the primary household appliances for the women labor force. Third, following their husbands (Agusta & Ghuzini, 2020), married women often work as unpaid labor for families (Meidika et al., 2019). One-fifth of working women (24.91%) are engaged in the agricultural sector (BPS - Statistics Indonesia, 2021). The study within occupations of married

women might assist in finding ways of supporting higher-skilled occupations and movement from lower-skilled occupations.

The study hypothesizes that household technology affects married women's labor force participation within white-collar, pink-collar, blue-collar, agricultural jobs, and full-time homemakers. The paper involves the additional category – homemakers – full-time workers with household duties (laundry, cooking, cleaning, etc.). The study employs a multinomial logit model with microdata from the Indonesia Demographic and Health Survey 2017 (National Population and Family Planning Board et al., 2018). The research contributes to developing the link between married female labor supply, particularly within occupations, and household technology from the perspective of developing countries. For policymakers, the study identifies the married women's occupations that household technology supports in Indonesia.

## Literature review

The leading theory of married FLFP is presented in the studies of Mincer's (1962) "labor force participation of married women" and Becker's (1965) "theory of the allocation of time." The theory of labor-leisure choices indicates that individuals either work for a salary or do a non-market activity (Borjas, 2016; Ehrenberg & Smith, 2012). However, Mincer (1962) pointed out that analyzing married women's labor force behavior, leisure, and work at home should be distinguished. Scholars stipulated that the family behaves as a single unit, and married women are involved in the collaborative decision-making process (Becker, 1965; Ehrenberg & Smith, 2012). According to Becker's (1965) allocation of time theory, women decide between the labor market and household production by comparing the value of their time in the labor market and at home. The effect of this decision depends on the elasticity of substitution between the home and the labor market in the household's utility function (Becker, 1965). Eventually, combining home and market production is essential for married women's labor force analysis.

In household modernization studies, Becker's (1965) household production approach was broadened. Studies in developed countries during the technological revolution implied saving time with household technology from household production and the impact on the increment of female labor supply viewpoints (Cavalcanti & Tavares, 2008; Greenwood et al., 2005; Lewis, 2014). Using data from the United States, Greenwood et al. (2005) pointed out that the diffusion of cheap, durable goods facilitated women's involvement in the labor market. Using OECD data, Cavalcanti and Tavares (2008), employing structural variables (average male income, government spending) and cyclical variables (growth rate of real GDP), highlighted a positive impact of technological advances on female labor force participation. Lewis (2014), using data from the United States, specified that technological advances indirectly increased female employment by increasing women's school attendance. These studies suggested that the impact of household technology was accompanied by economic and social change.

Regarding developing countries such as Nigeria, the Philippines, and South Africa, scholars using the approaches of developed countries (Coen-Pirani et al., 2008; Greenwood et al., 2005) found a positive impact of household time-saving appliance ownership (Dueso-Barosso, 2019; Mitschiener & Siy Van, 2018; Omotoso & Obembe, 2016). Some studies, such as in Nicaragua, South Africa, Peru, and India, explored the impact of electricity access on the reduction of

housework (Grogan & Sadanad, 2013) and the removal of gender differences in labor outcomes (Dasso & Fernandez, 2015; Dinkelman, 2011; Rathi & Vermaak, 2018; Sedai, 2021). Although the approaches of developing countries vary, the previous studies investigated the female labor force as a homogenous group.

Several recent studies investigated the impact of household technology within different categories of women's labor force participation. In terms of levels of education, there are mixed results in the literature. Some scholars from developed countries revealed that household modernization tends to favor women's participation in the labor market in relation to their level of education (Vidart, 2021). Nevertheless, several scholars using the dataset from the United States highlighted that household modernization does not affect women with a higher level of education with participation in the labor market. The studies found that labor force participation is associated with middle-level education (Bose et al., 2022) or the pink-collar sector (Cardia, 2008) since machines replace many manual tasks.

This finding suggests that household technology affects women's participation in the labor market, mainly those who can earn more than their created value in household chores. Few studies from developing countries revealed that household appliances significantly impact the employment of women with lower levels of education (Tewari & Wang, 2021). Recent studies from developing countries showed that access to electricity significantly affects non-agricultural employment (Chhay & Yamazaki, 2021; Tagliapietra et al., 2020). The mixed results of the studies revealed that household technology could provide the different outcomes of female labor supply with other occupations, education, and employment type.

Social norms play a significant role in the burden of housework and women's employment, particularly for married women or women with partners. Studies do not show that household improvement reduces the housework time for women (Bittman et al., 2004; Knapková & Považanová, 2021; Vu, 2019). These studies were followed by the bargaining power model, where individuals are egoistic and have different utility functions (Chiappori, 1988). Therefore, they did not satisfy the Beckerian notion of household production and did not investigate the impact on female employment.

Notably, some authors suggested that household technology was linked with the quality of housework; for instance, less time spent on cleaning and cooking and more on managerial activities (Bittman et al., 2004; Cardia, 2008). In addition, several studies mentioned that household technology has no significant impact on single women (Coen-Pirani et al., 2010; Suwadji, 2020). Married women are associated with homemakers, while husbands are breadwinners (Agusta & Ghuzini, 2020; Meidika et al., 2019); thus, married women are less mobile (Sedai, 2021; Suwadji, 2020). However, scholars who analyzed women's time allocation in the unitary model found positive results in an increase in women's labor supply when treating a family as a single unit to maximize utility (Greenwood et al., 2005; Omotoso & Obembe, 2016). Consequently, the effect of household technology adoption and the choice to participate in the labor market depends on women's responsibility towards their household.

In Indonesia, few studies investigated the impact of internet access on women's employment (Kusumawardhani et al., 2021; Sulistyaningrum et al., 2021; Suwadji, 2020). Suwadji (2020) investigated married and unmarried women and found a positive impact of access to the internet on the self-employment of married women with higher education. Another recent study explored the effects on micro and small enterprises in Yogyakarta (Sulistyaningrum et al., 2021). The studies emphasized that access to the internet allows women to work from

home while taking care of the home. Kusumawardhani et al. (2021) investigated the heterogenous impact within age groups and education levels on women's employment. They emphasized that internet availability is higher among younger women with a low level of education. The internet availability lowers the probability of women with a low level of education from working in the formal sector. Nevertheless, there is an absence of studies in Indonesia investigating the impact of primary household technology in homes, such as access to electricity and major household appliances.

Along with household technology, the decision of married women to work is also influenced by socioeconomic factors that include the family's characteristics, husbands' education level, age, place of residence, and other elements. The family characteristics are associated with the housework responsibilities of women (Grogan & Sadanand, 2013; Sulistyningrum et al., 2021). Agusta and Ghuzini (2020) indicated that the husband's characteristics are essential for the decisions of married women in Indonesia. Besides family, a higher level of education increases the possibility of participating in the labor market (Bose et al., 2022; Suwadji, 2020; Vidart, 2021).

Concerning age, studies indicated that women are employed later in life due to marriage and children (Chhay & Yamazaki, 2021; Dueso-Barosso, 2019). Some studies highlighted that before marriage, younger women have more possibilities of being employed (Vidart, 2021). Moreover, women residing in urban rather than rural areas are more likely to participate in labor market activities (Mitschiener & Siy Van, 2018; Omotoso & Obembe, 2016). Other factors, such the household wealth, influence decisions to participate in the labor market (Coen-Pirani et al., 2010; Sedai, 2021). In this research, the household technology represents the wealth of households. Regarding previous studies, this analysis situated in broader literature concerning the determinants of married women's workforce participation covers socioeconomic characteristics.

Regarding the above literature review, several studies focused on different effects of household modernization on women's employment in developing countries and Indonesia. However, there is no study of the female labor force within occupations in developing countries. This paper proposes verifying the hypothesis that household technology and socioeconomic variables affect married women's labor force participation within occupations in Indonesia differently. Based on theoretical and empirical background, household modernization should positively affect higher-skilled occupations and negatively affect lower-skilled occupations and homemakers.

## Data and methodology

### Data

The data were obtained from the Demographic and Health Surveys (DHS) Program, which was funded by the US Agency for International Development (USAID) (National Population and Family Planning Board et al., 2018). The data were collected by the National Population and Family Planning Board, Statistics Indonesia (BPS), and the Ministry of Health. The survey covered 34 provinces in Indonesia. Due to reaching representative statistics of the country, the distribution of the women in the sample was weighted. The data was imported from the Demographic and Health Surveys Model Household Questionnaire (The DHS Program, 2017)

and the Demographic and Health Surveys Model Woman's Questionnaire (The DHS Program, 2018). The sampling does not include nomadic and institutional populations. The sample design resulted in 50,730 households, from which 47,963 were successfully interviewed, yielding a 99% household response rate. Some variables were involved in the Household Questionnaire, such as the ownership of a washing machine and the number of sleeping rooms. In the Household Questionnaire, 49,627 women completed the interviews, yielding a response rate of 98%. Following DHS recommendations, merged data from the Household and Woman's Questionnaires were sorted by the cluster number, the household number, and the line number. In Indonesia, the DHS dataset included 49,584 respondents. Excluding non-married women and missing values, the data constituted a usable sample of 34,058 women aged 15–49 in Indonesia.

Table 1 presents dependent and independent variables used from DHS survey data for the empirical analysis. Occupations of married women are a dependent variable measured in five categories: white-collar, pink-collar, blue-collar, agricultural jobs, and homemakers (not working more than 12 months). In line with Basu et al. (2015), the married women's occupations in the labor force were grouped from the DHS survey: professional, technical, and managerial occupations as white-collar; clerical, sales, services, household, and domestic services as pink-collar; industrial, skilled manual, and unskilled manual jobs as blue-collar; and farming as agricultural. Thus, the dataset includes a category of homemakers for women who replied that they did not work in the past 12 months. Moreover, the women did not answer the question about their occupations in the labor market; if they replied that they were not working for less than 1 month, they then responded to the question of occupations.

**Table 1:** Descriptions of Variables

Variable		Description
<b>Dependent variable</b>		
Occupation (OC)		1: white-collar, 2: pink-collar, 3: blue-collar, 4: agricultural, 5: homemakers
<b>Independent variable</b>		
Factors of Household Technology (HT)	Ownership of electricity	Binary (1: ownership, 0: otherwise)
	Ownership of a private flush toilet with a septic tank	Binary (1: ownership, 0: otherwise)
	Ownership of refrigerator	Binary (1: ownership, 0: otherwise)
	Ownership of washing machine	Binary (1: ownership, 0: otherwise)
	Ownership of the vehicle	Binary (1: ownership, 0: otherwise)
	Ownership of mobile phone	Binary (1: ownership, 0: otherwise)
	Usage of internet	Binary (1: yes, 0: otherwise)
	Area of residence	Binary (1: urban, 0: rural)
Socioeconomic characteristics (SC)	Education	Categorical (1: no education or primary education, 2: secondary education, 3: higher education)
	Husband's education	Binary (1: higher education, 0: otherwise)
	Husband's occupation	Categorical (1: not working, 2: white-collar, 3: pink-collar, 4: blue-collar, 5: agricultural)
	Decisions made on purchases	Categorical (1: a wife and husband, 2: a wife, 3: a husband)
	Age	Continuous variable (year)
	Births in the last 3 years	Continuous variable (times)
	Eligible women in HH	Continuous variable (people)
	Sleeping rooms	Continuous variable (units)

Concerning the factors of household technology, the ownership of household appliances and facilities was counted by asking the respondents if they had household appliances and facilities in the household. The paper considers the ownership of a private flush toilet with a septic tank as a proxy for plumbing facilities inside the home and electricity access as a proxy for a decent household infrastructure. The literature suggests that access to basic household infrastructure is essential for the household to adopt household devices (Cubas Norando, 2010; Dinkelman, 2011; Tagliapietra et al., 2020). Therefore, the study adds the variables of information and communication technology (ICT), such as the mobile phone, the internet (Efobi et al., 2018; Sulistyningrum et al., 2021), and a vehicle as proxies of individual economic participation improvement (Tewari & Wang, 2021). The study includes the number of sleeping rooms as a proxy of the house size and the number of household members, which might be associated with the additional help for duties. Moreover, the study involves two household appliances—a refrigerator and a washing machine—since other variables, including microwave ovens, dishwashers, and clothes dryers, are not available in DHS data (Bittman et al., 2004; Greenwood et al., 2005; Omotoso & Obembe, 2016).

Socioeconomic characteristics complementary supplement the importance of household technology in home production. The study involves the area of residence, education level, and the husband's characteristics which indicate women's power in the household decision-making process, which relates to participation in the labor market. The three last covariates of socioeconomic characteristics (age, number of births, sleeping rooms, and number of eligible women) are associated with the responsibility for household care load, additional dependency, or support system for the reduction of housework.

## Methodology

The multinomial logit model (MLM) was chosen for the analysis because it focuses on the individual as the unit of analysis and uses the individual's characteristics as explanatory variables (Hoffman & Duncan, 1988). Ordinary least squares (OLS) and standard economic estimators are inappropriate for this study. The MLM is based on previous empirical studies (Omotoso & Obembe, 2016); however, the binary logit model is extended to more than two options. Accordingly, the MLM provides the most suitable econometric approach to estimate the effect of household technology on married women's labor force in selecting each occupational choice (Das, 2019; Greene, 2002; Gujarati, 2011).

The dependent variable of occupations was measured in five categories: white-collar (*w*), pink-collar (*p*), blue-collar (*b*), agricultural jobs (*a*), and homemaker (*h*). The symbol  $Y_i$  is if the married woman *i* is in choosing an occupation of category *j* ( $j=w, p, b, a, h$ ). The predicted probabilities of occupations for the five choices of being in the labor market are presented in the following equations (1-5):

$$P_n(Y_i = w) = \frac{e^{\beta_w HT_i + \beta_w SC_i}}{1 + e^{\beta_w HT_i + \beta_w SC_i} + e^{\beta_p HT_i + \beta_p SC_i} + e^{\beta_b HT_i + \beta_b SC_i} + e^{\beta_a HT_i + \beta_a SC_i}} \quad (1)$$

$$P_n(Y_i = p) = \frac{e^{\beta_p HT_i + \beta_p SC_i}}{1 + e^{\beta_w HT_i + \beta_w SC_i} + e^{\beta_p HT_i + \beta_p SC_i} + e^{\beta_b HT_i + \beta_b SC_i} + e^{\beta_a HT_i + \beta_a SC_i}} \quad (2)$$

$$P_n(Y_i = b) = \frac{e^{\beta_b HT_i + \beta_b SC_i}}{1 + e^{\beta_w HT_i + \beta_w SC_i} + e^{\beta_p HT_i + \beta_p SC_i} + e^{\beta_b HT_i + \beta_b SC_i} + e^{\beta_a HT_i + \beta_a SC_i}} \quad (3)$$

$$P_n(Y_i = a) = \frac{e^{\beta_a HT_i + \beta_a SC_i}}{1 + e^{\beta_w HT_i + \beta_w SC_i} + e^{\beta_p HT_i + \beta_p SC_i} + e^{\beta_b HT_i + \beta_b SC_i} + e^{\beta_a HT_i + \beta_a SC_i}} \quad (4)$$

Setting  $\beta_j = 0$ , the baseline category (homemakers):

$$P_n(Y_i = h) = \frac{1}{1 + e^{\beta_w HT_i + \beta_w SC_i} + e^{\beta_p HT_i + \beta_p SC_i} + e^{\beta_b HT_i + \beta_b SC_i} + e^{\beta_a HT_i + \beta_a SC_i}} \quad (5)$$

Where  $HT_i$  is the household technology factors of the married woman  $i$ ,  $SC_i$  is the socioeconomic characteristics of the married woman  $i$ .  $\beta_j$  is the coefficient vector and contains the intercept  $\beta_{0j}$  and the slope coefficients  $\beta_{kj}$ . Living in the household with any component of household technology factors reduces manual labor hours of married women at home and increases women's employment; for instance, the washing machine reduces the time for laundry, and the refrigerator reduces the time for cooking. Access to electricity facilitates the usage of household appliances, and access to sanitation improves cleaning and cooking hours.

The study assumes that the diffusion of household technology ownership within occupations means the frequent usage of household technology. The socioeconomic characteristics (age, education, household members, births, location, husband's characteristics) affect women's occupational choices. For instance, while a higher number of births increases labor hours at home, higher education, age, and urban location empower women to work less at home. The husband's characteristics influence the women's participation in the labor market; for instance, higher education negatively affects the wife's employment (Agusta & Ghuzini, 2020).

Predicted probabilities may be difficult to precisely determine whether a relationship can be established. Since the marginal effect is less sensitive to changes than the odds ratio (Wooldridge, 2010), the study calculates the marginal impact on interpreting the estimated model. The study can therefore discover  $\partial \Pi_{ij} / \partial HT_{ik}$  and  $\partial \Pi_{ij} / \partial SC_{ik}$ , which are the partial derivatives of  $\Pi_{ij}$  concerning the  $k$ th explanatory variable of household technology or socioeconomic characteristics (Gujarati, 2011). For the interpretation of results, the study presents marginal effects, which are interpreted as percentage point changes in the probability of the married women occupying a particular occupation associated with a one unit change in that explanatory variable (e.g., ownership of household technology) (Gujarati & Porter, 2009).

## Results and discussion

### Background of the case country

This study focuses on Indonesia, a member of the ASEAN region, where traditional gender roles for performing housework are profoundly rooted. These roles determine women's ability to join the labor market (Asian Development Bank, 2015). In 2019, the FLFP rate of Indonesian working-age women employed in formal jobs was 53.81%. It was one of the lowest rates in Southeast Asia countries compared to Cambodia (76.91%), Vietnam (72.73%), Lao PDR (76.49%), Singapore (61.91%), Brunei Darussalam (56.09%), and Thailand (56.09%) (World Bank, 2021). Thus, the Gender Inequality Index (GII) showed that Indonesia ranked 107th out of 189 countries, which indicates a low position of women in the labor market compared with men (United Nations, 2020). Eventually, the low status of women in the labor



market and unequal women’s involvement in the housework suggest that household technology might affect married women's labor force and different choices of occupations.

The “breadwinner and homemaker” model is maintained and strengthened in Indonesia, where women were considered responsible household members (Meidika et al., 2019). Indonesia is the largest Muslim population in the world, with 87% of the total population being Muslim (World Bank, 2019). Literature found that Muslim countries have the lowest FLFP (Psacharopoulos & Tzannatos, 1989). The historical treatment of women, and the current women’s position in society, suggest that the study of household technology is necessary within the heterogenous labor force of women.

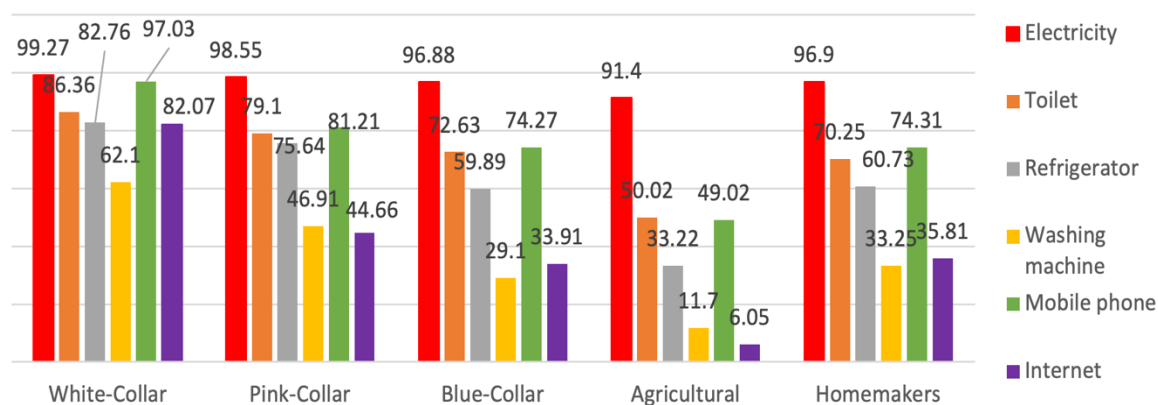
## Descriptive analysis

The sample of married women covers 7.55% (2,459) participating women in white-collar jobs, 32.49% (10,582) in pink-collar jobs, 7.28% (2,371) in blue-collar jobs, 15.92% (5,186) in the agricultural sector, and 36.72% women working as homemakers. The descriptive analysis presents the diffusion of household technology factors within occupations, and socioeconomic characteristics are the critical determinants of married women's labor force.

### Household technology factors

Figure 1 illustrates the diffusion of household technology within married women’s occupational choices.

**Figure 1:** Married Women Within Occupation by Household Technology Factors (%)



*Note: Based on data from the Indonesia Demographic and Health Survey 2017*

First, most women from white-collar jobs (with higher skills) lived in households with main household facilities (electricity, modern toilets), ICT, and household appliances. Whereas most female farmers did not have household appliances, and around half of them lived without modern toilets. Second, the household preferred to buy a refrigerator as the primary time-saving appliance for housework, while the washing machine was still “a luxury.” Third, almost every woman lived in a household with a vehicle, a more common attribute than a modern toilet. Thus, the results showed that main household facilities were more widespread than appliances and ICT. Generally, there is a big gap in possession of household technologies between women from white-collar jobs and farms, whereas owning a vehicle and having

access to electricity is equally distributed among occupations (“smaller gap among occupations”), and most women live with it.

### Socioeconomic characteristics

Regarding the level of education, in line with Human Capital Theory (Borjas, 2016), Table 2 shows that higher education assisted women in gaining the occupation in white-collar jobs, as well just 7.67% of women with higher education were homemakers. Concerning husbands’ occupations, the finding manifests that husbands were often involved in the same job category as their wives. The results suggest that women’s occupational choice depends on their husband’s presumptions about their occupational choice. The finding is consistent with Agusta and Ghuzini (2020), who found that husbands’ occupations influenced wives’ participation in the labor market in Indonesia. However, this insight does not communicate the input from husbands with household chores.

**Table 2:** Married Women Within Occupations According to Socioeconomic Characteristics (I)

	White-Collar	Pink-Collar	Blue-Collar	Agricultural	Homemaker
<b>Place</b>					
Urban	58.52%	65.00%	58.46%	11.94%	48.59%
Rural	41.48%	35.00%	41.54%	88.06%	51.41%
<b>Education</b>					
No education or primary	1.50%	27.62%	36.74%	61.20%	32.69%
Secondary	17.69%	57.23%	58.75%	37.74%	59.64%
Higher	80.60%	15.15%	4.51%	1.06%	7.67%
<b>Husband’s higher education</b>					
Yes	49.41%	15.57%	5.69%	2.45%	10.54%
No	50.59%	84.43%	94.31%	97.55%	89.46%
<b>Husband’s occupation</b>					
Not working	2.07%	1.80%	1.48%	0.93%	0.97%
White-collar	35.95%	9.02%	4.47%	2.31%	8.97%
Pink-collar	35.42%	51.62%	26.53%	9.06%	36.52%
Blue-collar	14.48%	22.74%	53.52%	12.96%	29.18%
Agricultural	12.08%	14.83%	14.00%	74.72%	24.35%
<b>Person who decides on purchases</b>					
A wife with a husband	68.52%	62.02%	61.45%	64.81%	59.58%
Wife	16.47%	17.89%	28.14%	12.57%	12.57%
A husband	15.01%	20.09%	20.41%	22.62%	22.62%

*Note: Based on data from the Indonesia Demographic and Health Survey 2017*

The descriptive statistics in Table 3 show that the homemakers’ group is the youngest among the other occupations.

**Table 3: Married Women Within Occupations According to Socioeconomic Characteristics (II)**

	<b>White-Collar</b>	<b>Pink-Collar</b>	<b>Blue-Collar</b>	<b>Agricultural</b>	<b>Homemaker</b>
<b>Age</b>					
Freq.	2,459	1,058	2,371	5,186	11,973
Mean	35.38	36.23	35.69	37.83	33.76
Std. Dev.	7.315	7.79	7.76	7.65	8.24
<b>Births in the last 3 years</b>					
Mean	.34	.23	.20	.17	.41
Std. Dev.	.51	.45	.43	.41	.54
<b>Eligible women</b>					
Mean	1.45	1.47	1.41	1.40	1.41
Std. Dev.	.78	.76	.68	.68	.70
<b>Sleeping rooms</b>					
Mean	2.75	2.46	2.35	2.26	2.35
Std. Dev.	1.20	1.13	1.09	1.10	1.05

*Note: Based on data from the Indonesia Demographic and Health Survey 2017*

Interestingly, homemakers and women from white-collar jobs had the highest birth rates in the last 3 years. This result suggests that small children are a barrier to women's employment (Mincer, 1962). The results also indicated that women from white-collar jobs had more childcare support, seeing as those women have the income to hire a nanny rather than withdraw from the labor market (Borjas, 2016; Ehrenberg and Smith, 2012). However, most employed women lived without an additional eligible woman in the household. Regarding the size of the home, married women from white-collar jobs lived in the largest houses.

## Estimation analysis

Estimating an MLM model of married women's occupational choice, Table 5 shows the R squared of the model for the dataset ( $R^2 = 0.2014$ ) (Anderson-Sprecher, 1994). The pseudo  $R^2$  is calculated based on log-likelihood in the model with a value between 0.2 to 0.4, indicating an excellent fit (McFadden, 1974). R squared is lower in this model since it predicts human behavior. Most independent variables are categorical and have many observations (Peterson, 1994). Thus, seven independent variables describing household technology are not directly related to the dependent variable. Due to data limitations, some main determinants of women's labor force participation are not considered, such as time spent on household tasks (Bittman et al., 2004; Omotoso & Obembe, 2016) and women's leisure time or the price of household appliances (Cavalcanti & Tavares, 2008). The paper use technology determinants as the proxy for the frequent usage of household technology and the reduction of household chores. Table 4 presents the estimation results of household technology factors within married women's occupations.

**Table 4:** Marginal Effects of the Household Technology's Factors on Married Women's Occupations

	White-Collar	Pink-Collar	Blue-Collar	Agricultural	Homemaker
Electricity	.0010 (.0130)	.0349 (.0209)	-.0187 (.0089)	-.0369*** (.0079)	.0197 (.0118)
Toilet with a septic tank	-.0045 (.0034)	.0175*** (.0062)	.0062* (.0037)	-.0125*** (.0035)	-.0067 (.0062)
Refrigerator	-.0013 (.0034)	.0787*** (.0062)	-.0150*** (.0036)	-.0460*** (.0036)	-.0164** (.0063)
Washing machine	-.0101*** (.0026)	.0228*** (.0059)	-.0197*** (.0039)	-.0331*** (.0049)	.0401*** (.0065)
Vehicle	.0019 (.0053)	.0020 (.0088)	.0149*** (.0051)	-.0014 (.0044)	-.0175* (.0085)
Mobile phone	.0310*** (.0062)	.0142** (.0072)	.0021 (.0039)	-.0257*** (.0039)	-.0216*** (.0069)
Internet	.0298*** (.0032)	.0367*** (.0065)	.0104*** (.0039)	-.0589*** (.0059)	-.0181** (.0070)
Observations		32,559			
LR chi2(84)		19,249.92			
Prob > chi2		(0.0000)			
Pseudo R2		0.2014			
Log-likelihood		-38,166.93			

Note: Standard errors are presented in parentheses; Significance levels are \*\*\* $p < .01$ , \*\* $p < .05$ , \* $p < .10$

The study considered basic household facilities of electricity and the modern toilet with a septic tank as the “conditions” for adopting household appliances. First, since almost every woman had electricity in the household, electricity did not provide an advantage to being involved in the labor market. Second, with other conditions remaining the same, if a married woman lived in a home with a modern toilet, her probability of occupying the pink-collar sector increased by 1.75%. In agreement with Cardia (2008), while the private flush toilet with a septic tank might not be essential time-saving equipment, modern indoor plumbing facilities might be connected to improving the houses and infrastructure.

Since cooking and cleaning are two of the most time-consuming household activities for married women (Bittman et al., 2004; Greenwood et al., 2005), the study includes two major household appliances (a refrigerator and a washing machine) as the possible reduction of the time spent on housework. The findings are mixed. First, assuming white-collar women are the first adopters of household technology, there was no significant impact on their participation. Consistent with Tewari and Wang (2021), the findings suggested that perhaps housework was more linked with childcare that is not changed by machines. Second, the effect was positive for pink-collar women. Supported by Bose et al. (2022) and Cardia (2008), the results suggested that the earnings for pink-collar jobs were higher than working as a homemaker compared with blue-collar or agricultural jobs. Third, the results showed that the ownership of a washing machine was linked with the probability of being a full-time homemaker. This finding was corroborated by the descriptive statistics shown in Figure 1, indicating that washing machines were not common in Indonesia. In line with Bittman et al. (2004) and Cardia (2008), this finding suggested that perhaps those homemakers with washing machines were from wealthier households and did not encourage women to join the labor market.

Concerning ICT, the findings indicated that living with ICT (internet, mobile phone) increased the likelihood of married women engaged in white-collar and pink-collar jobs. In line with Efobi et al. (2018) and Sulistyningrum et al. (2021), the results suggested that the accessibility of ICT in the household significantly expanded the availability of information about job vacancies and provided the flexibility of combining household chores (e.g., ordering foods, mobile commerce activities) with labor market work; thus, creating new possibilities of self-employment. Sulistyningrum et al. (2021) emphasized that internet access increased married

women working in micro and small enterprises in Indonesian cities (Yogyakarta and Bantul). Additionally, vehicle ownership provided an excellent advantage for married women from blue-collar jobs as it facilitated involvement in this sector in Indonesia since the diffusion of vehicles was very high (see Figure 1).

The results revealed a negative association between household technology and the participation of married women with lower skills in the labor market, such as farming and blue-collar jobs. In this context, linked with Cubas Norando (2010) and Greenwood et al. (2005), the results showed that the household purchases less technology if the women earned a lower salary than their created “value” at the house. As investigated by Dasso and Fernandez (2015), Tagliapietra et al. (2020), and Chhay and Yamazaki (2021), this finding was also associated with the shift of occupations regarding the effect of household technology. Particularly, Chhay & Yamazaki (2021) highlighted that electrification negatively affected agricultural employment while it positively affected non-agricultural self-employment. The authors suggested that this indicated the shift from agricultural employment to non-agricultural employment in Cambodia. Therefore, household technology provides an advantage in occupations for women with higher-level.

Regarding the homemakers, the results showed that, in general, household technology (except washing machines) decreased the likelihood of being full-time involved in household chores. In line with Dueso-Barosso (2019), Greenwood et al. (2005), and Omotoso and Obembe (2016), the findings revealed that household technology could potentially assist in improving labor force participation of married women. Married women choose to work since their earnings give them higher intra-household power (Tewari & Wang, 2021). Besides empowerment in the household, the earnings helped raise children and offered social and self-realization benefits (Sulistyaningrum et al., 2020).

Additionally, the study included socioeconomic variables in Table 5 to supplement the importance of household technology to married women's labor force participation. The results revealed that the likelihood of married women engaging in white-collar, pink-collar, and farming jobs increased with age. Thus, on average, women who gave birth within three years had lower probabilities of being involved in pink-collar, blue-collar, and agricultural jobs. However, there was no significant impact on women within white-collar jobs. Additionally, the marginal effects highlighted that the probability of being a homemaker increased by 15.25% if a woman gave birth within the last three years. It suggested that most women were affected by the incompatibility of carrying small children and doing work at the market. The results were in tandem with other Indonesian studies (Agusta & Ghuzini, 2020; Meidika et al., 2019; Sulistyaningrum et al., 2021). Additionally, this finding pointed out that the husbands were not involved markedly in the household chores.

**Table 5:** Marginal Effects of Socioeconomic Characteristics on Married Women's Occupations

	<b>White-collar</b>	<b>Pink-collar</b>	<b>Blue-collar</b>	<b>Agricultural</b>	<b>Homemakers</b>
<b>Urban</b> (reference – rural)	-.0247*** (.0024)	.0789*** (.0052)	.0256*** (.0032)	-.1083*** (.0042)	.02851*** (.0056)
<b>Education</b>					
No education/ primary education	Ref.	Ref.	Ref.	Ref.	Ref.
Secondary education	.01913*** (.0013)	-.0004 (.0061)	.0069* (.0038)	-.0224*** (.0037)	-.0032 (.0064)
Higher education	.3074*** (.0121)	-.0044 (.0116)	-.0420*** (.0060)	-.0913*** (.0090)	-.1697*** (.0112)
Husband's higher education	-.0108*** (.0027)	-.0066 (.0096)	-.0173** (.0074)	.0149 (.0105)	.0198* (.0113)
<b>Husband's occupation</b>					
<b>Not working</b>	Ref.	Ref.	Ref.	Ref.	Ref.
White-collar	.0022 (.0131)	-.0962*** (.0253)	-.0531*** (.0164)	-0.140 (.0150)	.1610 (.0249)
Pink-collar	-.0508*** (.0127)	-.0198 (.0240)	-.0450*** (.0157)	-.0342** (.0133)	-.1113*** (.0230)
Blue-collar	-.0456*** (.0130)	-.1537*** (.0242)	-.0644*** (.0158)	.1786*** (.0136)	.0851*** (.0233)
Agricultural	-.0456*** (.0130)	-.1537*** (.0242)	-.0644*** (.0158)	.0786*** (.0136)	.0851*** (.0233)
<b>Decisions made on purchases</b>					
A wife with a husband	Ref.	Ref.	Ref.	Ref.	Ref.
A wife	-.0007 (.0031)	.0258*** (.0070)	.0034 (.0043)	-.0256*** (.0045)	-.0028 (.0072)
A husband	-.0159*** (.0026)	-.0244*** (.0058)	-.0091** (.0036)	.0014 (.0038)	.0507*** (.0062)
<b>Age</b>	.0012*** (.0002)	.0026*** (.0004)	-.0004* (.0002)	.0028*** (.0002)	-.0062*** (.0004)
<b>Births in the last 3 years</b>	.0023 (.0023)	-.0687*** (.0057)	-.0338*** (.0038)	-.0524*** (.0042)	.1525*** (.0055)
<b>Eligible women</b>	-.0030* (.0016)	.0045 (.0037)	-.0017 (.0024)	-.0011 (.0026)	.0014 (.0039)
<b>Sleeping rooms (units)</b>	.0001 (.0009)	-.0012 (.0024)	.0024 (.0015)	-.0012 (.0017)	-.0032 (.0026)

Note: Standard errors are given in parenthesis; Significance levels are \*\*\* $p < .01$ , \*\* $p < .05$ , \* $p < .10$

Education was also a significant determinant for occupations of married women's labor force participation. The results showed that, with other conditions remaining the same, women with tertiary education were more likely to participate in white-collar jobs. Thus, with other conditions remaining the same, the higher education level decreased for married women involved in the blue-collar, agricultural, or homemakers. The results collaborated with theories of Human Capital Theory (Borjas, 2016), considering that where social norms are strong, requiring women to be primary homemakers, jobs in the white-collar sector might be viewed as "more appropriate" jobs for women (Jayachandran, 2020). For instance, jobs in government institutions include maternity leave, child allowances for married women with children, and day-to-day work schedules in Indonesia. Moreover, preferences for these jobs are linked with fulfilling their skills, income, and bargaining power in the household.

The results showed that married women's participation depended on their husbands' characteristics. Interestingly, the husband's employment in pink-collar or white-collar jobs decreased, on average, the probability of a woman joining any occupation. Moreover, the findings revealed that the tertiary education of the husbands and high husbands' decision power were negatively related to married women's employment in white-collar jobs. Reflecting on the studies by Bayudan (2006), Ehrenberg and Smith (2012), and Augusta and Ghuzini (2020), the results could be indirectly connected with higher incomes of husbands with higher education, which might mean higher decision power for husbands about

household production and labor market. In addition, the higher decision-making power of women, on average, increased the probability for a married woman to be involved in pink-collar jobs. At the same time, it decreased the likelihood of a married woman being engaged in the agricultural sector. The results suggested that higher decision-making power increased the probability of being employed in better-paid occupations (Bose et al., 2022).

## Conclusion and policy implications

A significant contribution of this study is that it investigates the female labor force within categories and adds the homemakers that help to indicate how the effects of household technology vary within the different occupations of married women. First, the study concludes that the ownership of household technology reduces inactive married women in the labor market (homemakers). Second, it manifests that higher education, internet, and mobile phone usage positively influence married women's labor force from pink-collar and white-collar occupations. For a policy implication, estimation emphasizes that aside from promoting the attainment of tertiary education, facilitating the accessibility of information and communication technology might support married women in white-collar jobs. Third, household modernization and high women's decision power on purchases increase married women's participation in pink-collar jobs. For the policy implication, the paper suggests the availability of household devices and the development of plumbing facilities facilitates women labor force with middle skills. Fourth, the study declares that household technology negatively affects female farmers and blue-collar workers. Thus, it reveals that giving birth in the last three years and a husband's employment and higher education are negatively related to married FLFP. Aside from household technology, Indonesia should focus on women's empowerment for the policy implication.

Consequently, the study presents household modernization positively associated with choosing particularly pink-collar jobs and a negative association with agricultural, blue-collar, and homemakers' jobs, which suggests the shift in female occupational choices. For the general implication, the government assistance in affordability of significant household appliances would support a change from homemakers, agricultural, and blue-collar jobs to pink-collar jobs. The subsequent research could explore the differences in occupational choices by adding more variables, such as the husband's time with housework and household decision-making. Moreover, it is necessary to investigate the category of homemakers within heterogeneous effects (informal employment and self-employment occupational choices). Additionally, the involvement of other developing countries where married women are determined as responsible for household duties would strengthen the findings of this research.

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