An Insight into Informal Sector Employment: The Case of Female Workers in Rural West Bengal

Santanu Bhattacharya [1], **and Souvik Dasgupta** [2]

[1]Research Scholar, Department of Economics, Sidho-Kanho-Birsha University, Purulia, West Bengal, India
[2]Assistant Professor, Department of Economics, Sidho-Kanho-Birsha University, Purulia, West Bengal, India

Correspondence should be addressed to Santanu Bhattacharya ; santanueco789@gmail.com

ABSTRACT- Female labour force participation is a key indicator of economic growth, especially in developing countries like India. This study, based on a household survey in Purulia, West Bengal, examines the determinants of informal work and wage factors among female workers. The study has used correlation matrix, one-way ANOVA and post hoc test. Sample selection models were applied to correct selection bias. The explanatory variables age, material status, numbers of child and monthly contribution of other household members were found to have a significant impact on the probability of female informal labour force participation. We found that the probability of engaging in the farm activities by the female workers were significantly influenced by their age, marital status and volume of land owned. The regressors age, year of experience in present work, nature of work, working hour, place of residence had significant impact on the wage-determination of female workers in informal sector.

KEYWORDS: Informal Sector, Female Worker, One-Way ANOVA, Bonferroni method, Sample Selection Bias, Heckman Selection Model, Probit-Selection Model

JEL Classification Number: C01, D01, J01

I. INTRODUCTION

Female labour force participation is an important indicator of economic growth and development especially for developing countries like India. It would change in the pattern of economic growth, educational attainment, fertility rates, social norms, and other factors. After World War II women were force to move towards labour market to maintain their economic status because many male solider died during the war. In India percentage of women labour force participation is very low compared to men. According to NFHS-5(2019-2021) only 32% of married girls and women aged between 15-49 years are participating in labour market compared to 98% of men in the same aged group. The labour force participation rate among women in this age group shows a marginal increase to 32% in NFHS-5 as compared to 31% as recorded in NFHS-4.In a developing economy there is a direct relationship between poverty and female labour force participation. Informal sector has an important contribution in India's GDP, near about 50% of national product are coming from this sector. As per the report of State Bank of India's (SBI) economic research department India's informal economy has goes down near about 15-20 per cent of the formal GDP in 2021 as against 52 per cent three years ago. As per the Global Gender Gap Index 2022, India is one of the lowest performers in the world respect to "health and survival" sub-index. India placed 135 ranked among 146 nations. Developing countries like India are suffers through gender wage pay gap, it is one of the major barriers in the way economic growth and development. The gender pay gap in India is widest among the world, as per the report of Global Gender Gap Report 2021 women are earning on an average 21% of men income. Participation of female workers in informal sector is a complex manner in developing countries like India, so it is important to find out on the basis of which factors female workers are choosing their informal work nature and the factors that determine her wage in informal sector. The present work is focused on informal-sector employment of working-age females.

We briefly review the underlying studies explaining women's labour force participation and labour supply with focus on developing countries. Becker [4] states that the neoclassical economists consider education as an important determinant of women entering in labour market. The higher level of women education associated with greater women labour force participation. Tienda and Glass[10] fitted Tobit model and found that in the United States as adult member in a household increases the probability of participation in labour market of the mother increases who were head of the households. They conclude that the women labour force participation is positively related to their age and education but inversely related to the income of the other family members. They also highlighted that employment status of household head has a considerable impact on women labour force participation. El-Hamidi[6] argued that the factors age, level of education, demographic, social and financial characteristics have an impact on the decision of the labour supply in Egypt. They also concluded that these determinants are work effectively on the basis of their poverty level. Edwige and Herve L.W[5] did a comparative study on women labour force participation in Zhejiang, China. They fitted Probit regression model for their analysis and found age, education, material status, other adult members in family have a significant impact on women labour force participation. They also concluded

that presence of children in a household found to be an insignificant of women labour force participation. Aemkulwat [1] examined the labor supply decisions of married couples across Thailand's formal and informal sectors, emphasizing the importance of considering both economic sectors when analyzing female labor supply behavior. The study demonstrated that couples allocate their labor time differently between formal and informal employment in response to household needs and prevailing economic conditions. Atieno [2] investigated female participation in Kenya's informal sector, demonstrating that informal employment constituted a critical livelihood strategy for women when formal sector opportunities were constrained. This work underscored the significance of the informal economy in comprehending overall patterns of female labor force participation in developing countries. Babalola and Akor [3] conducted an empirical analysis of married women's labor force participation in Adamawa State, Nigeria, contributing to understanding of how regional economic conditions and local labor market structures shaped female employment decisions. The study provided insights into the African context of women's economic participation. Hamid and Al-Jalali [8] provided a micro-level analysis in Pakistan examining the determinants of women's labor supply, emphasizing that participation decisions involved multiple household members and constraints. Their work highlighted the importance of understanding labor supply as a household-level decision rather than an individual choice. Hill [9] conducted a comparative analysis of female labor force participation in both developed and developing countries, with particular attention to the role of the informal sector. The study demonstrated that the informal sector provided distinct employment opportunities for women, particularly those facing barriers to formal sector entry. Hafeez and Ahmad [7] investigated factors determining labor force participation among educated married women in Punjab, finding that education did not automatically translate into workforce participation. Their research identified specific household and family factors that influenced whether educated women engaged in paid employment. The rest of the article is organized as follows. In the next section we have narrated the research objectives, followed by sample selection and description of variables used in the analysis. Further, we have analysed the socio-economic characteristics using different statistical techniques and then after we have specified econometric models along with the empirical findings. Finally, we give the conclusion.

II. RESEARCH OBJECTIVES

The present study attempts to address the following two objectives:

- To determine the factors based on which female workers are choosing the informal work nature.
- To examine the factors which are influencing the wage of female workers in informal sector.

III. DATA AND VARIABLE DESCRIPTION

The present work is based on a household survey conducted during Feb 2023- June 2023in Purulia district of West Bengal (India).At present there are four sub-divisions

under Purulia district, out of which we have selected Raghunathpur subdivision as our study area because most of the areas in this sub-division is rural and different castes can be seen living here. Raghunathpur sub-division contains 6 community development blocks namely Kashipur, Para, Neturia, Santuri, Raghunathpur–I and Raghunathpur–II. Wesurveyed 299 households from purposively selected four villages namely Kolloli, Sonathol, Bundla and Gopinathpurof Kashipur and Raghunathpur-I community development blocks. The Table 1 gives the socio-economic profile of the above-mentioned villages.

Table 1: Demographic Distribution of the Sample Villages

BLOCK	**KASHIPUR**		**RGNP-I**	
VILLAGE	Kolloli	Sonathol	Bundla	Gopinathpur
Household	303	355	193	391
Population	1524	1586	1057	1882
Child(0-6)	164	158	134	333
Schedule cast	676	476	753	219
Schedule tribe	17	0	246	175
Literacy (%)	79	75	59	80
Total worker	425	630	296	491
Main worker	353	270	94	277

Source: Census of India (2011)

The present study considered working-age female member(s) of any household those who were not working in any government or formal sector activities into analysis. Moreover, for any household if it was found that more than one female member was working, we considered the female member with higher wage earning. The household survey was conducted using a constructed questionnaire.

Table 2: Variable Description

WAGE :	Average monthly income of the female workers in informal sector (₹)
EDU:	Years of schooling of the female respondent.
EXP:	Years of experience of the female workers on present work in informal sector.
HEDU:	Years of schooling of the household head.
WORK:	Employment (informal) status of the female respondent, WORK =1 if employed, otherwise=0.
WNATURE:	Informal work nature of the female workers. If Farm activities=1, otherwise= 0.
CHILD:	Number of children of the female respondent in the age group less than 14yrs.
HH60 :	Number of members in a household above 60 years.
NLABINC:	Total income of the household except the female respondent's income (₹).
MSTATUS:	Material status of the female respondent, if Married=1, otherwise=0.
CASTE:	Social category of the female respondent, If Unreserved=1, otherwise=0.
BLOCK:	Residence of the female respondent, if Kashipur=1, otherwise=0.
LAND:	Having agriculture land in terms of Bigha.
BPL:	Having BPL card or not. If yes=1, otherwise=0.

IV. SOCIO-ECONOMIC CHARACTERISTIC OF SAMPLE HOUSEHOLDS

We have used some simple statistical tools like percentage, mean and coefficient of variation to the present socio-economic status of the sample households. For statistical analysis of data, we used One-Way ANOVA. To determine paired wise comparison, select Bonferroni method as our post hoc test which is the popular method for comparing all possible groups.

Table: 3 Descriptive Statistics of continuous variables

Variable	N	Mean	CV	Max.	Min.
AGE	299	31.8	0.3	61	16
EXP	202	3.58	0.48	8	1
EDU	299	4.94	0.82	15	1
HEDU	299	9.16	0.36	15	0
CHILD	231	1.65	0.4	3	0
OLDAGE	299	1.57	0.72	3	0
WAGE	202	3723	0.31	8000	1000
WHOUR	202	5.36	0.27	10	2
NLABINC	299	5541	0.47	15000	0
LAND	299	3.83	1.21	37	0.5

Source: Authors' own calculations

As per the Table 3 average age of the female respondent is near about 32years with coefficient of variation 0.3. In the sample maximum and minimum ages of female respondents are 61 and 16 years respectively. An average year of experience of the females who are involving with some informal sector activities is near about 3.5years. In the sample maximum experience of the female workers is 8 years and minimum 1. The average year of schooling of the female respondents is near about 5 years, which indicates that the female respondents in the sample are well not educated. In the sample highest years of schooling of the female respondent is 15 years and lowest 0 (illiterate). We found that average year of schooling of the household head's is near about 9years with coefficient of variation 0.36. This low coefficient of variation indicates that the sample households are consistent respect to their head's education. A highest year of schooling of the household head is 15 years and lowest 0 (illiterates).In the sample maximum number of children of the married female respondents below 14 years is 3 and minimum 0. Average number of children in the sample that married women respondent having is 1.65. From the table we found that on an average there is a single old age member in the sample households. From the above table we found that the mean of average monthly income of the female respondents is ₹3723. Here the coefficient of variation is 0.31. Highest average monthly income of the female respondents in our sample is 8000₹ and lowest is ₹1000.We found that average working hour of the female respondents who are participating in informal sector activities is near about 5 hours. We found that the average monthly non labour income of the female respondent family is near about ₹5541 with coefficient of variation 0.47. In the sample highest non labour income of the female respondent's family is ₹15000 and lowest 0. Non labour income of the female respondent's family zero shows that female respondent is the only earner of that family. In the sample female respondents are having on an average near about 4 Bigha agriculture land.

A. *Average monthly wage of female workers in informal sector: Analysis of One Way ANOVA and Post Hoc test respect to their social category*

Now we want to check that is there any statistical difference between mean of average monthly wage of the female workers in informal sector corresponding to their social category. To do so we fitted one way analysis of ANOVA. Our null hypothesis is that all means of monthly average wage of the female workers in informal sector corresponding to their social categories are equal. On the other hand, our alternative hypothesis is that all means are not equal.

$$H_0: \mu_1 \, (GEN) = \mu_2(OBC) = \mu_3(SC) = \mu_4(ST)$$

$$H_A: All \, \mu \, are \, not \, equal$$

We may present our results in a summary in the following manner.

Table 4: Analysis of Average Monthly Wage of Female Workers in Informal Sector with Respect to Social Category

ANALYSIS OF VARIANCE					
Source	SS	df	MS	F	Prob.> F
Between groups	3.4084268	3	1.13614226	10.6	0.000
Within groups	21.256765	198	0.1073574		
Total	24.665192	201	0.1227124		

Source: Authors' own calculations

From the Table 4 we find that p-value is 0.0000 which indicates that our null hypothesis is rejected that means mean of average monthly wage differs across to their social category. This conclusion does not rule out the possibility that some them are equal, so here we interested to find which pair of mean differs. Now to find pair wise comparisons of means we used a post hoc test. Here we have four social categories General, OBC, SC, and ST so we need six comparisons to cover all combinations of groups. We select Bonferroni method as our post hoc test which is the popular method for comparing all possible groups.

We may present our results in a summary in the following manner.

Table 5: Pair-Wise Comparisons of Average Monthly Wage of the Female Workers in Informal Sector with Respect to Social Category

POST-HOC	General	OBC	SC
OBC	-0.08814		
	1		
SC	-0.04675	0.041385	
	1	1	
ST	-0.2166	-0.30474	-0.25799
	0	0.009	0

Source: Authors' own calculations

The p-values of the Table 5 point out the group comparisons that are significantly different. From this result we find that 3 group of comparisons are significantly different namely ST-GENERAL, ST-OBC, ST-SC. Rest all other comparisons are statistically insignificant which indicates that average monthly wage of female workers in informal sector is not significantly differs between other pairs.

V. ECONOMETRIC SPECIFICATIONS & RESULTS

In this section we gave the descriptions of econometric analysis and results respect to our specific objectives.

A. Work Nature Determination of Female Workers in Informal Sector Activity

Here we analysed the factors which are influencing the work nature of the female workers in informal sector. As the sample suffered from selection bias problem, Probit model with selection fitted to correct it.

The Probit model with sample selection assumes that there exists an underlying relationship

$$WNATURE_i^* = \beta_0 + \beta_1 AGE_i + \beta_2 EDU_i + \beta_3 HEDU_i + \beta_4 MSTS_i + \beta_5 SOCIAL_i + \beta_6 LAND_i + u_{1i} \dots \dots (1) \quad \text{[Latent equation]}$$

Such that we observe only the binary outcome

$$WNATURE_i^{probit} = (WNATURE_i^* > 0) \dots \dots (2) \quad \text{[Probit equation]}$$

The dependent variable is not always observed. We assumed that $WNATURE_i$ is observed if

$$(WORK_i = \gamma_0 + \gamma_1 AGE_i + \gamma_2 EDU_i + \gamma_3 HEDU_i + \gamma_4 MSTS_i + \gamma_5 SOCIAL_i + \gamma_6 CHILD_i + \gamma_7 NLABINC_i + \gamma_8 HH60_i + \gamma_9 LAND_i + \gamma_{10} BPL_i + u_{2i}) > 0 \dots \dots (3) \quad \text{[Selection equation]}$$

where,

$$u_{1i} \sim N(0,1)$$
$$u_{2i} \sim N(0,1)$$
$$corr(u_{1i}, u_{2i}) = \rho$$

When $\rho \neq 0$, if we apply Standard probit techniques to the first equation this will yield biased results. Heckprobit provides consistent, asymptotically efficient estimates for all the parameters in such models. We have fitted the following regression equations for the estimation. We may present our results in a summary in a following manner at Table 7.

Table 6: Work Nature Determination of Female Workers in Informal Sector Activity

Probit model with sample selection			Number of obs. = 299	
			Censored obs. = 97	
			Uncensored obs. = 202	
Log likelihood = -159.7174			Wald chi2(6) = 14.00	
			Prob > chi2 = 0.0296	
	Coefficient	SE	p	
WNATURE(Farm= 1, otherwise=0)				
AGE	0.1098844	0.043689	0.012	
EDU	-0.0385559	0.021423	0.072	
HEDU	-0.0201948	0.014003	0.149	
MSTS	0.1110995	0.298175	0.031	
SOCIAL	-0.0007577	0.024194	0.975	
LAND	0.3038862	0.137003	0.027	
Constant	1.549215	0.692152	0.025	
Work(Yes=1, No=0)				
AGE	-0.0870701	0.030684	0.005	
EDU	-0.0571802	0.048733	0.241	
HEDU	-0.9097771	0.137582	0.123	
MSTS	3.138063	0.812538	0.000	
SOCIAL	-0.092704	0.333443	0.638	
CHILD	1.184648	0.31981	0.009	
NLABINC	-0.0003794	0.000096	0.000	
HH60	0.0761862	0.151873	0.616	
LAND	-0.0029941	0.028416	0.916	
BPL	0.2262716	0.251327	0.294	
Constant	11.9716	1.847663	0.000	
Athrho	-5.815495	1.911787	0.034	
rho	-0.9999822	0.003622		
LR test of indep.eqns.(rho=0);	chi2(1)=12.19	Prob > chi2 = 0.0005		

Source: Authors' own calculations

Form the Table 7 we found that $Prob > \chi^2$ is 0.02, which indicates that the fitted model is significant as a whole. The value of ρ is significant (0.005) which indicates that the error term of the two equations is correlated with each other. On the other hand, significant $ath\rho$ justify the existence of selection bias problem in the sample. Age, material status, number of children, non labour income of the household has significant impact on the probability of working age females to participate in informal sector activities. Form the result we found that as age of the female workers increases the probability to participating in farm sector activities increases compare to nonfarm activities. Those who are married having the higher probability to participate in farm sector activities compare to others. Female workers those who are having more agriculture land have the higher probability to engage in farm sector activities compare to compare to others.

B. Wage Determination of Female Workers in Informal Sector Activity

Here we analysed the factors which are influencing the wage of the female workers in informal sector. As the

sample suffered from the selection bias problem, Heckman selection model fitted to correct it.

The Heckman selection model assumes that there exists an underlying regression relationship-

$$\ln(WAGE_i) = \beta_0 + \beta_1 AGE_i + \beta_2 AGE_i^2 + \beta_3 EXP_i + \beta_4 EXP_i^2 + \beta_5 EDU_i + \beta_6 WNTR_i + \beta_7 WHR_i + \beta_8 SOCIAL_i + \beta_9 BLOCK_i + u_{1i} \ldots\ldots\ldots (4) \quad [Structual Equation]$$

The dependent variable is not always observed. We assumed that $LOG(WAGE)_i$ is observed if

$$(WORK_i = \gamma_0 + \gamma_1 AGE_i + \gamma_2 EDU_i + \gamma_3 HEDU_i + \gamma_4 MSTS_i + \gamma_5 SOCIAL_i + \gamma_6 CHILD_i + \gamma_7 NLABINC_i + \gamma_8 HH60_i + \gamma_9 LAND_i + \gamma_{10} BPL_i + u_{2i})$$
$$> 0 \ldots\ldots.. (5) \quad [Selection equation]$$

where,

$$u_{1i} \sim N(0,1)$$
$$u_{2i} \sim N(0,1)$$
$$corr(u_{1i}, u_{2i}) = \rho$$

When $\rho \neq 0$, standard regression techniques applied to the first equation yield biased results. Heckman provides consistent, asymptotically efficient estimates for all the parameters in such models.

Table 7: Wage Determination of Female Workers in Informal Sector Activity

Heckman selection model			
Number of obs= 299			
(regression model with sample selection)		Censored obs = 97	
Uncensored obs = 202			
Wald chi2(9) = 441.77			
Log likelihood = 6.28949		Prob > chi2 = 0.0000	
	Coefficient	SE	p
LNWAGE			
AGE	0.077773	0.018752	0.000
AGE2	-0.00116	0.000286	0.000
EXP	0.01271	0.003326	0.000
EXP2	-0.005	0.005133	0.330
EDUX	0.034616	0.036797	0.347
WNATURE	-0.11801	0.032423	0.000
WHOUR	0.0326	0.010289	0.002
SOCIAL	-0.00488	0.041669	0.907
BLOCK	0.155011	0.037085	0.000
Constant	6.475549	0.304504	0.000
WORK			
AGE	-0.10382	0.024839	0.000
EDU	-0.03723	0.041604	0.371
HEDU	-0.76158	0.917566	0.146
MSTATUS	2.671297	0.697132	0.000
SOCIAL	-0.07242	0.28238	0.798
CHILD	1.380082	0.523822	0.008
NLABINC	-0.00026	0.000077	0.001
HH60	0.052154	0.143759	0.717
LAND	-0.01429	0.026096	0.584
BPL	0.296304	0.351516	0.399
Constant	10.73881	1.69191	0.000
athrho	0.750946	0.351266	0.033
lnsigma	-1.62696	0.049903	0.000
rho	0.635713	0.209309	
sigma	0.196527	0.009807	
lambda	0.124935	0.042418	
LR test of indep. eqns. (rho = 0):	chi2(1) = 5.34	Prob > chi2 = 0.0208	

Source: Authors' own calculations

Form the table-8 we found that $Prob > Chi^2$ is 0.00, which indicates that the fitted model is significant as a whole. The value of ρ is significant (0.02) which indicates that the error terms of the two equations are correlated with each other. On the other hand, significant athρ justify the existence of selection bias problem in the sample. Age, material status, number of children, non labour income of the household has significant impact on the probability of working age females to participate in informal sector activities. Form the result we have found that age of the female workers has positive significant impact on the wage of informal sector but the square of age inversely related

with the wage of female workers in informal sector. The present study found that an increase in year of experience on present job of the female workers leads to higher wage in informal sector. Those who are participating in farm sector activities are earning more wage compare to non farm sector activities. From the results we found that increase in working hour leads to more wage of the female workers in informal sector. Female workers those who are lives in a Kashipur block are earning more wage in compare to Raghunathpur-I.

VI. CONCLUSIONS

The present study is an attempt to investigate on the basis of which factors the female workers are choosing their informal work nature and what are the factors that determines their informal sector wage. We have selected Purulia district from West Bengal as our study area, because as per the NITI-Aayog (2021) report it is the multi-dimensionally poorest district among all the districts in West Bengal. As a whole we surveyed 299 households from purposively selected 4 villages under Raghunathpur subdivision in Purulia district. To prepare the report we have used some simple statistical tools like percentage, mean and coefficient of variation. For statistical analysis of data, we have used One-Way ANOVA and correlation matrix. To determine paired wise comparison, select Bonferroni method as our post hoc test which is the popular method for comparing all possible groups. For econometric analysis we have fitted probit model with selection and Heckman selection model to overcome the problem of selection bias in the sample. To check that is there any difference between mean of average monthly wage of the female workers in informal sector corresponding to their social category, we fitted one way analysis of ANOVA. From result we found that mean of average monthly wage of the female workers in informal sector differs across to their social category. To find pair wise comparisons of means we used Bonferroni method as our post hoc test. The comparisons ST-GENERAL, ST-OBC and ST-SC have statistically significant that shows the mean of average monthly wage of the female workers in informal sector differs across these groups. Age, material status, number of children, non labour income of the household has significant impact on the probability of working age females to participate in informal sector activities. Form the result we found that as age of the female workers increases the probability to participating in farm sector activities increases compare to nonfarm activities. Those who are married having the higher probability to participate in farm sector activities compare to others. Female workers those who are having more agriculture land have the higher probability to engage in farm sector activities compare to others. The present study found that age of the female workers has positive significant impact on the wage of informal sector but the square of age inversely related with the wage of female workers in informal sector. We have found that an increase in year of experience on present job of the female workers leads to higher wage in informal sector. Those who are participating in farm sector activities are earning more wage compare to non farm sector activities in informal sector. From the results we have found that increase in working hour leads to more wage of the female workers in informal sector.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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