Workplace sanitation and female labour force participation in the informal sector

Lokesh Posti
Jindal Global Business School, OP JINDAL GLOBAL UNIVERSITY, Sonipat, India

Rajan Khare
University of British Columbia - Okanagan Campus

Rahul Kumar
Indian Institute of Management Sambalpur

Abstract

This study focuses on the issue of sanitation in developing countries impacting female labour force participation. Using the context of the informal sector, which, although marginalised, supports a sizable share of the workers in the economy, we analyse National Sample Survey Office (NSSO) 73rd round survey, 2015-16, on informal firms. We find a positive impact of toilet availability on the share of female workers in an informal firm. Heterogeneity concerns were addressed by categorising firms into different sizes as per the MSME (Micro, Small and Medium Enterprises) classification, and endogeneity concerns were addressed using instrumental variable (IV) regression and propensity score matching (PSM) technique.

1. Introduction

Advancing gender equality is not just a fundamental right; it also makes economic sense. Globally 3.6 billion people lack safely managed sanitation services (WHO, 2021). Although it is accepted that unsanitary practices cause diseases (Amin et al., 2020), there is still a dearth of studies on the economic consequences of sanitation, such as labour supply. Taking the context of two marginalised sections of the economy - the informal sector and women – we try to find if there is any statistical causal relationship between sanitation and female labour force participation (FLFP) among the Indian informal firms. The issue gains relevance due to the recent implementation of the grand sanitation program *'Swach Bharat Mission* in India, which made significant efforts to accomplish the dream of an open defecation-free (ODF) society by 2030, aligning with the Sustainable Development Goals (SDGs).

With a contribution of 40% to the national GDP and employing about 1 million workers (PLFS, 2018), the economic significance of the informal sector cannot be ignored. Moreover, in a patriarchal society like India, where females are primarily limited to domestic work, their possible assimilation into the workforce, even if in the informal sector, can significantly augment the country's growth potential.

The study contributes to the literature by going beyond the socio-cultural aspects of sanitation and instead analysing its economic consequences by pondering over the issue of providing equal work opportunities for the females through which we can ensure that they earn more, learn more, own more resources and therefore can have a positive impact on individuals, families, communities and economies. Thus, using the context of informal firms, the study revolves around the research question: *Does access to toilet at workplace increase female labour force participation?*

2. Conceptual Framework

Globally the FLFP stands at 45% relative to a participation rate of 76% for men, however, this gender gap in the workforce is further accentuated in fast-emerging countries like India where it is among the lowest (ILO, 2017). Despite the significant improvement in the literacy levels among females, from 16.83% in 1951 to 65.46% in 2011 (Government of India, 2011), FLFP was only 28.5% in 2017 relative to 82.5% male labour force participation (World Economic Forum, 2017). If FLFP matches male workforce participation rates, India could be 27% richer (Lagarde & Ostry, 2018). Involvement of the females in the labour force has significant socio-economic implications as females are found to invest almost 90% of their earnings into their families and communities[1] thus contributing to a healthier tomorrow.

The informal sector is seen as an employer of last resort in developing economies where the formal employment structure is still underdeveloped and the government's capability of employing all or spending on unemployment pensions is very limited. For the ever-increasing

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[1] https://www.wfp.org/our-work/preventing-hunger/focus-women/women-hungerfacts

workforce, the informal sector acts as a cushion and thereby contributes to tackling the third-world problems of unemployment, poverty and inequality.

22% of the global population still lacks access to basic sanitation services[2]. The problem is more serious in developing countries where inadequate sanitation is the leading cause of poverty, primarily because it causes premature mortality (1800 child deaths per day) and other adverse health impacts[3]. Females being the most vulnerable section of society, the problems of basic sanitation are extremely harsh on them thus impacting their overall well-being which includes health and safety. The sixth sustainable development goal (SDG) recognises access to safe sanitation as an essential factor for future social development and economic prosperity.

Ensuring satisfactory working conditions is widely recognized as a significant factor influencing female labor force participation (FLFP). It comprises four key elements: employment conditions, social protection, workers' rights, and social dialogue (Ghai, 2003). Among these components, sanitation and hygiene, along with adequate remuneration, are particularly important under employment conditions. International discussions often revolve around the implementation of Voluntary Codes of Conduct (VCC) by corporations, aiming to address concerns about unacceptable working conditions (Pearson, 2007). VCCs have played a role in improving both monetary and non-monetary benefits, such as access to sanitation and hygiene facilities like portable toilets in the workplace (Smith & Dolan, 2012). The informal sector is notorious for its low wages and unsafe working conditions, including inadequate sanitation, which disproportionately affects women workers, making them more vulnerable (Mohapatra, 2012).

The study considers two possible channels through which improved sanitation services at the workplace (access to functional toilets) can impact labour supply; (a) better health translates into additional working days/hours (Wang & Shen, 2022), and (b) improved safety environment makes the workplace more female friendly (Sudarshan & Bhattacharya, 2009).

3. Data and Methodology

The study used the latest available nationally representative cross-sectional survey on informal enterprises by *National Sample Survey Office (NSSO) 73rd round 2015-16*. After managing the outliers and the missing data issues, we were left with 287,456 firms spread across all the major sectors and political states.

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[2] https://www.who.int/news-room/fact-sheets/detail/sanitation
[3] https://washmatters.wateraid.org/blog/sanitation-saving-lives-in-developing-countries

Table 1: Summary Statistics

Variables	Description	Observations	Mean	Std. Dev.	Min	Max
Toilet_access	Whether the firm has access to a functional toilet (0=No OR 1= Yes)	242717	0.563	0.495	0	1
ValueAdded_LP_log	Value Added labour productivity (log)	288,169	8.75	0.94	0	14.43
Mkt_conc	Market concentration (HHI index)	289,356	0.02	0.06	0.00	1.00
labour_log	total firm employment (log)	289,356	0.68	0.74	0.00	8.01
investment_log	total loan amount (log)	289,356	1.59	3.97	0.00	23.72
Capital_log	total owned tangible assets (log)	289,356	12.75	1.83	0.00	25.58
ElectricityUsed_ratio	ratio of Electricity expenses to Total expenses	235,146	0.08	0.14	0.00	1.00
Firm_Age	Years of operation since inception	289,356	10.27	8.61	0	193.0
SkilledWkers_Ratio	ratio of Skilled workers to Total firm employment	289,356	0.63	0.45	0	1.00
Female_Share	Ratio of Female workers to Total workers in a firm	242716	0.186	0.336	0	1
Female_tot	Total female workers in a firm	242712	0.574	1.85	0	48
Govt_assitance	government support in the last three years in the form of aid, subsidy, etc. (0=No OR 1= Yes)	242716	0.012	0.111	0	1

To examine the impact of sanitation on female labour participation at the firm level,

$$Y_i = \alpha + \beta\, Toilet\_access_i + \gamma\, X_i + \mu_i \tag{1}$$

Where, Y_i = share of female workers in the ith firm

X = vector of control variables

We also used the *Tobit regression model*, which describes the relationship between a non-negative dependent variable and one or more independent variables. The dependent variable can be censored between a lower and/or upper limit or could characteristically lie within a specific limit, as in our case where the share of female workers lie between 0 and 1.

To make our results more conclusive, we need to address the endogeneity issues, as there is always a concern regarding the direction of a causality between Toilet access and female workers' share. On the one hand, firms with better sanitation facilities like functional toilets can provide a conducive work environment for the females, thereby increasing the female share of workers: whereas on the other hand, firms with a higher share of female workers can bargain/demand for better sanitation facilities. Thus, in addition to our baseline analysis, we employ propensity score matching (PSM) technique to analyse the results.

We construct a matched sample using the *PSM technique* to decompose the average treatment effect. Assuming *Toilet access* as a treatment/event, in the absence of any experimental data, using a counterfactual framework via the PSM technique, we randomise the ex-post facto data, thus helping us adjust the selection bias and decomposing the treatment effect. The counterfactual analytical framework permits the estimation of potential outcomes in treated and untreated groups. Our PSM model majorly controls for observable firm-level characteristics, except for the latent unobservables features, such as firms' management style.

By using the PSM estimator, we checked for the treatment effects assuming *Toilet access* as a treatment where some firms were under the treatment group, and some were untreated, i.e. under the control group. *The propensity score*, generated via logistic regression, is the conditional probability of treatment given the background/observable variables. Hence instead of controlling for all the confounding variables, PSM sufficiently controls for the one-dimensional *propensity score* to address the selection bias (Rosenbaum and Rubin, 1983).

$$e(x) = \Pr(T = 1|X = x) \tag{2}$$

Where, *e(x)* = estimated propensity using a probability function – Pr (.)

T = binary treatment indicator observing whether the firm has Toilet access

X = background observed covariates

T=1 if the firm receives the treatment (has access to a functional toilet), and *T*=0 if the unit does not receive the treatment (does not have access to a functional toilet). *X* is the vector of variables that control for the observable characteristics among the firms – log of Capital, log of Investment, log of Labour, Firm Age and Firm location.

The outcome variable *Y* is taken as the share of female workers. *Y(0)* denotes the potential outcome for the firm under control, and *Y(1)* is the potential outcome under treatment. The estimated propensity scores *e(x)*, are matched with their nearest neighbours. The average causal impact of the treatment is measured by the average treatment effect (ATE), which can be further decomposed into the average treatment effect on the treated (ATT) and average treatment effect on the untreated (ATU).

$$ATE = E[Y(1) - Y(0)] \tag{3}$$

$$ATT = E[Y(1)\text{-}Y(0)|T\text{=}1] \tag{4}$$

$$ATU = E[Y(1)\text{-}Y(0)|T\text{=}0] \tag{5}$$

4. Results

Table 2 shows our baseline model results; relative to a firm having no access to toilets, access to toilets increases the share of women workers in an informal firm by 13.1%. After adding firm and industry-level controls (Column 3), we find that access to the toilet increases the female share of participation by 4.52%. All our results stand statistically significant at the 1% level. Additionally we also changed our dependent variable to *'Total Female workers'* and re-estimated the model and found similar results (Table 2, Column 4) that toilet access increase the absolute number of female workers in the informal firm.

Our main dependent variable, although continuous in nature, lies between 0 and 1, thereby having a clear upper and lower limit. Thus, allowing us to use Tobit regression analyses on our baseline model to verify our claims. Table 3 shows the marginal effects of toilet access on the female share of workers. Column 1 shows that, on average, access to the toilet increases the female share by 4.52%, similar to our initial results. To further explore the heterogeneous impact of toilet access, we classified the firms based on the firm size as MSMEs, since bigger firms are assumed to have more considerable resources at disposal. As a result, we find that access to toilets increases the female workforce by 4.45%, 5.78% and 4.35% among *Micro*, *Small* and *Medium* enterprises, respectively, at a 1% significance level (Columns 2, 3 and 4 of Table 3).

Table 2: Impact of Toilet access on female share of workers in a firm - Linear regression Results[4]

	(1) Female_Share	(2) Female_Share	(3) Female_Share	(4) Total Female workers
Toilet access=Yes	0.131***	0.0468***	0.0452***	0.319***
	(0.00130)	(0.000790)	(0.000789)	(0.0057)
Constant	0.113***	0.942***	0.945***	1.606***
	(0.000826)	(0.00479)	(0.00476)	(0.0585)
Observations	242717	242676	242676	242676
Adjusted R^2	0.037	0.684	0.686	0.219
Firm-level controls	No	Yes	Yes	Yes
Industry-level control	No	No	Yes	Yes
F stat	10122.79***	28811.36***	20693.2***	1039.27***

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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[4] Full results consisting of control variables can be available on request.

Table 3: Tobit results - Marginal effects of Toilet access on Female share of workers[5]

I. **Dep Var:** Female Share	(1) All Firms	(2) Micro	(3) Small	(4) Medium
Toilet Access				
No	0	0	0	0
	(.)	(.)	(.)	(.)
Yes	0.0452***	0.0445***	0.0578***	0.435***
	(0.000789)	(0.000791)	(0.00943)	(0.0734)
Constant	0.945***	0.947***	0.335***	0.157
	(0.00476)	(0.00477)	(0.0568)	(0.100)
Observations	242676	239363	3225	88
Pseudo R^2	1.752	1.766	2.588	2.010
Log lik.	60335.3	61007.3	605.4	17.11
Firm and Industry controls	Yes	Yes	Yes	Yes

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.1 Robustness Check

As a measure of robustness, using the PSM technique (Table 4) we find that firms having access to the toilet have a relatively 3.26% higher female share. Decomposing this effect, ATT results show that among the treated firms, they would have had 3.46% less female share without toilets. Whereas ATU results show that firm not having toilet access could have had 3% more female share.

Table 4: PSM results

Dep Var: Female_Share	(1) ATE	(2) ATT	(3) ATU
Toilet vs. No Toilet	0.0326***	0.0346***	0.0300***
	(0.00177)	(0.00256)	(0.00157)
Observations	242676	242676	242676

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In addition, we perform a comprehensive analysis to evaluate the robustness and consistency of the initial findings. Specifically, we assess the potential impact of selection biases resulting from unobservable factors on our estimates. To achieve this, we adopt the methodology introduced by Oster (2019). This approach

[5] Full results consisting of control variables can be available on request.

allows us to measure the stability of our estimated parameters by examining how selection biases affect observable variables. We make the assumption that the selection on unobservable factors is proportionate to the selection on observable variables, enabling us to identify any potential presence of omitted variable bias. Through this procedure, we calculate a test statistic called *delta (δ)*, which indicates the magnitude of omitted variable bias needed to completely eliminate the observed effects of our primary independent variable - '*Toilet access*'. Thus, this approach ensures robustness by assuming a specific value for *R_max* and determining the corresponding value of δ, where *β=0*. As recommend in the literature, we set the value of *R_max* as 1.3 times the R^2 from the primary model including the set controls (Sangwan & Kumar, 2021; Oster, 2019), i.e. *R_max* = 1.3*0.686 = 0.89.

Table 5: Bound Estimate

delta (δ)	1.52636	
---- Inputs from Regressions ----		
Uncontrolled	0.131	0.037
Controlled	0.045	0.686
---- Other Inputs ----		
R_max	0.890	
Beta	0.000	
Unr. Controls		

The test results presented in Table 5 demonstrate that the influence of potential omitted variables would need to be quite substantial. Specifically, these variables would have to be around 1.5 times (δ =1.5) more significant than the effects of the covariates currently included in Model (3) in Table 2, to statistically nullify our results (β=0).

In summary, our study delved into the relationship between toilet access and the female share in informal firms. While definitive causality within the intricate informal sector remains elusive due to complexities and potential unobservable factors, our research carries significant importance as a foundational exploration of this understudied area. Data limitations constrained our ability to comprehensively address all variables, prompting the application of diverse econometric techniques to bridge the analytical gaps. Although a direct causal link was not firmly established, the observed close statistical association offers valuable directions for future research.

Our findings underline the need for richer data sources to enhance our understanding of the topic. Moreover, advancements in econometric methodologies could better address omitted variable bias, contributing to a more nuanced grasp of the interplay between *toilet access* and the *female workforce* in the informal sector. As we proceed with cautious interpretation, our study advances the discourse and sets the stage for more robust investigations in the future.

5. Conclusion

Female empowerment through female employment and enhancing better health through providing basic sanitation facilities are among the key issues in developing countries and hence of great policy interest. Studies have shown that economic empowerment of women leads to various positive externalities like improvement in entrepreneurial skills and lower fertility rates (Bandiera et al., 2020), significant savings amount the rural women leading to higher decision making abilities (Ashraf et al., 2010) and may also lead to protection from intimate partner violence (Dalal, 2011).

Thus, economic empowerment of women focuses on enabling them to attain financial independence and improve their socio-economic status. It involves providing equal opportunities, resources, and support for women to participate in economic activities. This empowerment allows women to have greater control over their lives, promotes gender equality, and contributes to the well-being of families and communities. Strategies for achieving women's economic empowerment include skills training, access to credit and financial services, the promotion of entrepreneurship, ensuring equal pay, and addressing gender biases. Supportive policies and legislation are essential for sustaining economic empowerment. Women's economic empowerment plays a vital role in fostering inclusive and sustainable societies.

Through this study, the impact of sanitation on female workforce participation is explored by observing that access to toilet at the workplace increases the share of women workers. Furthermore, heterogeneous impacts were observed across different firm sizes. Various other methods, such as PSM techniques, were employed as a measure of robustness but fell short of establishing causality. However, the results did indicate a statistically significant association between the variables of interest.

Based on the findings, the following suggestions are put forward: Firstly, organisations should continue to promote basic infrastructure for providing decent working conditions that render gender equality which may have direct implications on firm productivity. Secondly, sanitation has a direct impact on health; thus healthy workforce has higher production potential. In addition, apart from the big structural changes that the economy needs, which require a longer gestation period, smaller efforts like improving basic sanitation facilities can augment higher female labour force participation, indirectly addressing issues like women empowerment which is a key socio-economic concern in developing countries.

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