Working women and caste in India: A study of social disadvantage using feature attribution

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Working women and caste in India

Working outside the house is a social-stigma for women in India.

Only the poorest women are working in blue-collar jobs.

Once their family income increases, they withdraw from the workforce.

Women re-enter the work force at high education levels in white-collar jobs.

Scheduled castes and Scheduled tribes (Sc/St) = socio-economically disadvantaged.

$\Longrightarrow$ **Caste is an important determinant of a woman's work-status in India.**

Our Questions:

1. **Is the ability to infer a woman's work-status based on her caste changing over generations?**
2. **What is the change in the effect of caste on work-status over generations?**

Data and Empirical Methodology

We use a nationally representative dataset from the **National Family Health Survey conducted in 2015-16 (NFHS-4)** consisting of **81,816** women aged 21-49 years across all 29 states and 7 union territories of India.

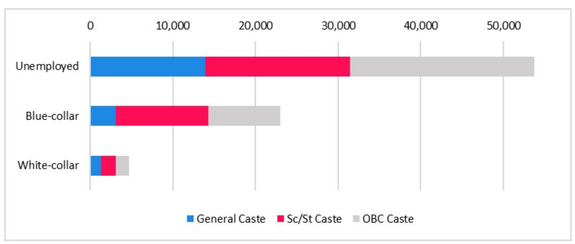

Figure 1: Distribution of number of women from each caste across work-status types

We design three binary classification experiments to predict a woman's work. We train an ensemble **Gradient Boosting Decision Tree (GBDT)** model for each experiment using LightGBM.

Table 1: Training and test set performance for GBDT models. Best parameters were found using 5-fold cross-validated grid search.

Experiment/Description	Class Balance	Training		Test	
		Acc.	F1	Acc.	F1
Having a job or not (***work-status***)	0.34	0.69	0.60	0.67	0.57
Having a blue collar job or not (***blue-collar***	0.28	0.71	0.59	0.68	0.55
Having a white collar job or not (***white-collar***)	0.05	0.89	0.51	0.85	0.30

SHAP feature attribution framework

Our models uncover non-linear temporal patterns between caste and women's work-status using the SHAP (SHapley Additive exPlanation) feature attribution framework.

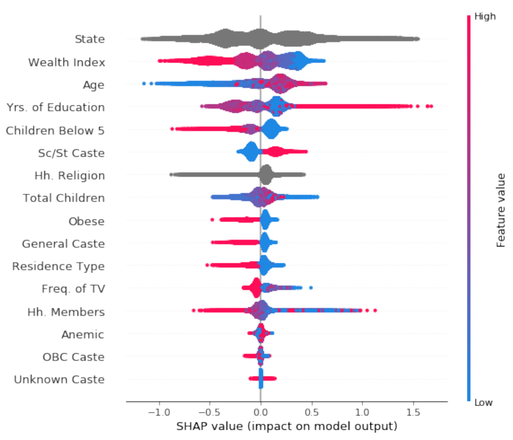

Figure 2: SHAP summary plot for ***work-status*** experiment. Categorical variable values are grey.

The SHAP summary plot for *work-status* experiment in Figure 2 shows the relative importance of features, the distribution of impacts of features on the model's prediction, as well as how the feature's value (Low to High) relates to its impact.

Impact of caste on work-status across states of India

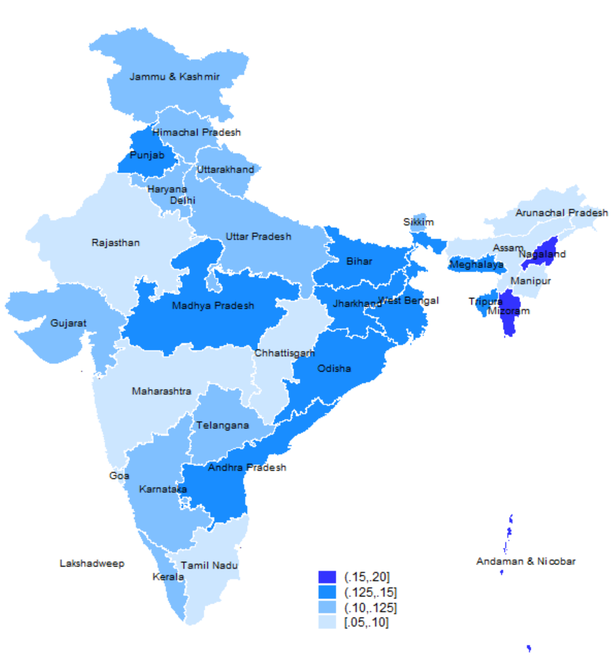

Figure 3: Mean of the magnitude of SHAP values of Sc/St Caste across states of India for ***work-status*** experiment

Impact of caste on work type over generations

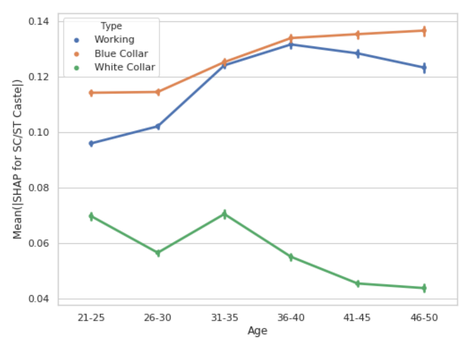

Figure 4: Mean of the magnitude of SHAP values of Sc/St Caste across 5-year age-bins.

Caste is more important in predicting work-status of older women than of younger women.

Same pattern is observed for blue-collar jobs. For white collar jobs, there isn't a clear monotonic pattern, but overall, caste is more important for women younger than 35 years of age.

Impact of caste on work-status using SHAP interaction effects

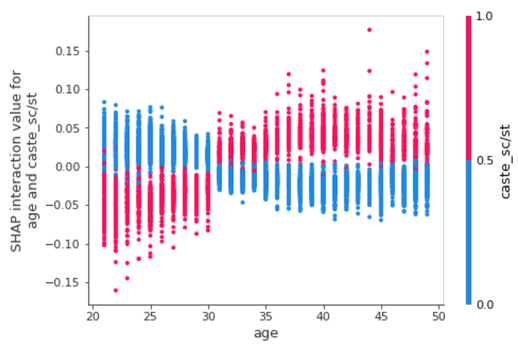

Figure 5: SHAP interaction plot of age and Sc/St Caste for ***work-status*** experiment.

For younger Sc/St women, SHAP interaction values are larger negatives, implying a high prediction for not-working.

For older Sc/St women, SHAP interaction values are larger positives, implying a high prediction for working.

Impact of caste on blue collar and white collar jobs

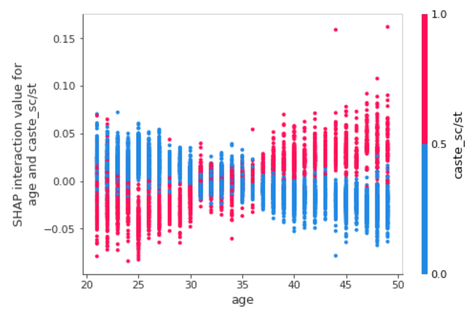

Figure 6: SHAP interaction plot of age and Sc/St Caste for ***blue-collar*** experiment.

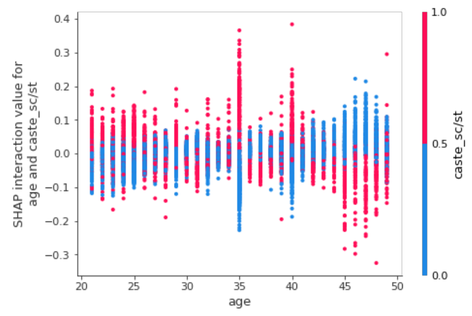

Figure 7: SHAP interaction plot of age and Sc/St Caste for ***white-collar*** experiment.

The pattern observed in Figure 5 is only relevant for blue-collar jobs (Figure 6).

Opposite pattern is observed for white-collar jobs (Figure 7). Younger Sc/St women are more likely to be working in white-collar jobs while older Sc/St women are less likely to be working in white-collar jobs.

Conclusions and implications

Conclusions

- Caste has become a less important determinant of younger women's work-status, specially their participation in blue-collar jobs.
- Younger women of Sc/St caste are less likely to be working in blue collar-jobs, and more likely to be working in white-collar jobs.

Implications

1. **Monitoring:** A cost-effective tool to monitor the impact of the existing caste-based quotas set by the Government of India in public education and jobs.

2. **Targeting:** Future work will look deeper into geographical variations to identify regions where younger women are lagging, and job creation can be targeted.

3. **Discovering:** Can be used to study the nuanced patterns underlying other social disadvantage and bias in both developing and developed countries.

Code and Data

All code, datasets and results available at `github.com/chaitjo/working-women`

References

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