



Rainfall Shocks and the Gender Wage Gap: Evidence from Indian Agriculture

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Summary. — In the context of climate change and its effect on poverty, previous studies have shown that productivity shocks in agriculture, such as rainfall variability, affect wages adversely. None of the studies, however, consider the heterogeneity in the impact of these shocks on agricultural wages by gender, a feature which has been studied for demand shocks in urban labor markets for developed countries. Using National Sample Survey data for India from 1993 to 2007, a district-level panel dataset is created to examine how a rainfall shock affects the gender wage gap. The study shows that both female and male wages are positively related to rainfall shocks. Hence, future studies must study the impact of labor market shocks in rural areas on both female and male wages separately. It also finds that the female-to-male wage ratio is significantly positively associated with a rainfall shock in regions where rainfed rice is cultivated, i.e., low (high) rainfall reduces (increases) the female-to-male ratio. The study demonstrates that this result is due to a positive association of demand for female labor with rainfall in these rainfed rice-growing regions. This finding is consistent with the greater marginal value of female labor in rice cultivation, which is also a crop highly sensitive to rainfall variability under rainfed conditions. The paper concludes that the effect of a rainfall shock on the gender wage gap depends upon the gender roles underlying the technology of production, which varies across cropping systems.

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1. INTRODUCTION

Labor economists have long been concerned with measurement of wage gaps across demographic groups like gender, race, and ethnicity. The immediate question of interest that has received much attention is why these gaps exist. These gaps have been shown to exist due to differences in characteristics (demographic characteristics like age, education, marital status, and number of children, or job characteristics like full-time or part-time job, industry, and occupation (Hertz *et al.*, 2009)), differential returns to similar characteristics, and prevailing labor demand and supply conditions across males and females (Blau & Kahn, 2003). The second question of interest, which has received comparatively less attention, is how these wage gaps respond to shocks that change labor productivity.

Very few studies examine the changing nature of wage gaps between demographic groups due to a tightening or a boom in the labor market, and these too are restricted to urban labor markets in developed countries. O'Neill (1985) and, more recently, Biddle and Hamermesh (2011) analyze the impact of aggregate changes in unemployment rates in the economy on the gender gap in wages using data from the United States. O'Neill (1985) finds that the gender wage gap increases when high unemployment rates prevail in the economy. This finding is attributed to the possible greater vulnerability of females to layoffs due to less training, and in general a weaker labor market for females during recessions. Biddle and Hamermesh (2011) also find that the gender wage gap is countercyclical in nature. They attribute this to greater discrimination against females during downturns. Contrary evidence to the above is presented in Solon, Barsky, and Parker (1994), Park and Shin (2005), and Marchand and Olfert (2013). Using other datasets and time periods for the United States, they estimate that the gender wage gap is procyclical in nature. This, they argue, is due to males being overrepresented in industries with

more procyclical demand. Aller and Arce (2001) also find that the gender wage gap reduced during the 1990–94 economic recession in Spain due to a proportional increase in service employment.

In the Indian context, there is scanty literature on the effect of demand shocks on labor market outcomes. The only related study that the author is aware of is by Bhalotra (2010), who finds that a decrease in state-level income (a proxy for recessionary conditions in the labor market) increases women's labor force participation in the agriculture sector. The author interprets this finding as distress labor among women when income is low (income effect on female employment). During a recession, employment in the manufacturing and service sectors falls, so working in the agriculture sector can act as a last resort for females to supplement family income. There is no study in the context of a developing country that looks at the impact of demand shocks on the gender wage gap. The existing studies in the Indian context either study the gender wage gap in any given year (Mahajan & Ramaswami, 2015), or the trends in gender wage gap in Indian agriculture over time (Himanshu, 2005).

Table 1 shows the female-to-male wage ratio in agriculture across 14 Indian states as taken from the National Sample Survey (NSS) rounds of 1993–2007. It can be seen from the table that there is a persistent gap in the daily wage rate received by females and males in Indian agriculture. During the period of study, the all-India average female daily wage rate in agriculture was 72% of that of male agricultural labor.¹ The real daily wage in agriculture changes in response to demand shocks each year. In general, this effect can be different for male and female daily wages. One of the shocks that the agricultural labor market is continually subject to is rainfall variability across years. In the past few decades, climate change has made rainfall more variable in India, leading to

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Table 1. Female-to-male wage ratio for casual laborers in agriculture

State	1993 (%)	1999 (%)	2004 (%)	2007 (%)
Andhra Pradesh	72	67	65	70
Bihar	87	88	87	89
Gujarat	98	89	90	99
Haryana	85	90	84	83
Karnataka	73	68	69	70
Kerala	70	63	59	63
Madhya Pradesh	83	85	83	86
Maharashtra	63	65	63	68
Orissa	73	79	72	77
Punjab	99	94	83	88
Rajasthan	75	80	81	89
Tamil Nadu	57	58	54	52
Uttar Pradesh	75	78	83	84
West Bengal	88	89	88	94
All India	72	72	70	74

Source: National Sample Survey (1993, 1999, 2004, 2007), Employment and Unemployment Schedule (Author's calculations).

recurrence of drought-like situations across different parts of the country. Each year some part of the country suffers from rainfall scarcity, leading to low agricultural output. This affects the livelihood of people dependent on agriculture in rural India. Of the 22 major countrywide droughts witnessed in India in the last 120 years (1890–2010), seven have occurred in the last three decades (NIDM, 2009).² Coupled with the low irrigation levels in India (44.3% of the area sown), these rainfall shocks have a large impact on agricultural output.³ Sources of irrigation such as canals and groundwater also get depleted during drought years. These shocks affect agricultural productivity and hence, change demand for labor in Indian agriculture.

Since agriculture plays a pivotal role in employment generation in developing countries (according to the Ministry of Home Affairs, Government of India (2011), 73% of the rural workforce in India is engaged in agriculture), any disruption in the agricultural labor market has an impact on a large section of the working population. In terms of gender composition, about 80 (69)% of the female (male) workforce in rural India is engaged in agriculture (Ministry of Home Affairs, Government of India, 2011). Female agricultural laborers constitute 55% of the female agricultural workforce. Given the large participation of females as agricultural laborers, the effect of rainfall shocks on daily wage for females cannot be overlooked.

It has been recognized in the literature that climatic shocks may not have gender neutral effects (WEDO, 2008) and that adaptation to changing climate can also vary between males and females (Van Aelst & Holvoet, 2016). The variability in demand for labor in agriculture due to natural rainfall shocks can also have an impact on the gender wage gap in agriculture. The impact depends on the asymmetric effects of rainfall variability on the demand for male and female labor in agriculture, and the asymmetric supply responses of male and female labor to these shocks. This is the first study which estimates the impact of a demand shock in rural labor markets on the gender gap in agricultural wages. The demand shock considered is the variability in rainfall over time. A district-level panel dataset of daily wages and rainfall variability along with other control variables is constructed to examine the above question. Any differential effect of the rainfall shock on the gender wage gap in regions that cultivate rainfed rice in India is also estimated. The motivation to examine this heterogeneous

ity comes from the existing literature on gender roles across cropping systems, the details of which are provided in Section 2.

In the next section, a literature review of studies estimating the impact of weather variability on labor market outcomes is provided. Section 3 discusses the data and the variables constructed and Section 4 elucidates the empirical strategy, discusses the main findings, and conducts robustness checks. This is followed by a discussion of mechanisms behind the main findings in Section 5, while Section 6 presents a summary of the results. Concluding remarks are gathered in Section 7.

2. LITERATURE REVIEW

Previous studies by Jayachandran (2006), Mueller and Osgood (2009), Mueller and Quisumbing (2011), and Burgess, Deschenes, Donaldson, and Greenstone (2011) look at the effect of weather shocks on wages. Jayachandran (2006) measures the impact of productivity shocks on district-level daily agricultural wage for men in India and concludes that an increase in productivity shock increases the real male wage significantly. This effect is less pronounced in districts which are more developed in terms of access to roads and banks. Mueller and Quisumbing (2011) study the impact of the 1998 Bangladesh flood on agricultural and non-agricultural wage rates. They find a short-term reduction in real wage and a smaller reduction in wage for agricultural workers who were able to find non-agricultural employment. Mueller and Osgood (2009) look not only at the short-term effects of droughts on earnings but the long-term effects as well. They argue that the long-term effect can be due to selling of productive assets during the shock to sustain consumption; and it may take a long time to replenish them. They use data on both rural and urban areas in Brazil and find that adverse rainfall shocks up to five years in the past can have negative effects on individual incomes.

The literature on the heterogeneous effect of weather shocks on labor market outcomes by gender is thus largely non-existent.⁴ This paper aims to fill this gap by examining the dimension of wage rates and the consequent effect of weather shocks on male and female wage gap in agriculture. It builds on the paper by Jayachandran (2006), which examines the short-term effects of a rainfall shock on daily male wage levels in Indian agriculture.⁵ Only the daily wage in agriculture is considered in this paper since women in rural India are primarily engaged in agriculture, as discussed earlier in the introduction.

The existing literature does not offer an *a priori* hypothesis about what the effect of rainfall shocks on the gender wage gap should be. It depends on the effect of rainfall shocks on both the supply of and the demand for female and male labor (see Appendix 1 for a theoretical formulation). Empirically, to construct a hypothesis on the possible effect of rainfall shocks on the gender wage gap, we look at the literature on the supply and the demand side.

(a) Supply side

There is no existing evidence on the effect of rainfall variability on supply of female and male labor. Some studies show that female labor can act as a last resort for families in times of distress (Bhalotra, 2010). This implies that if there is an equal effect of rainfall shocks on the demand for male and female labor in agriculture, then female wage can be more responsive to such shocks than male wage (given equal fall in demand,

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