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Changing wage structure in India in the post-reform era: 1993–2011

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Abstract

This paper documents the changing structure of wages in India over the post-reform era, the roughly two-decade period since 1993. To investigate the factors underlying these changes, a supply-demand framework is applied at the level of the Indian state. While real wages have risen across India over the past two decades, the increase has been greater in rural areas and, especially, for unskilled workers. The analysis finds that, in rural areas, the changing wage structure has been driven largely by relative supply factors, such as increased overall education levels and falling female labor force participation. Relative wage changes between rural and urban areas have been driven largely by shifts in employment, notably into unskilled-intensive sectors like construction.

JEL Classification: J21, J23, J24, J31

Keywords: Labor supply, Labor demand, Rural wages in India

1 Introduction

Poverty in India has fallen rapidly in recent years (e.g., Dang and Lanjouw 2015). Evidence now suggests that steeply rising wages of unskilled labor have been a major driver of this trend (Balcazar et al. 2016).[1] Yet, still unclear is *why* unskilled wage growth has been particularly strong and, more broadly, what economic forces are shaping India's labor market transformation. In this paper, we investigate changes in the structure of wages in India over the post-reform era, the roughly two-decade period since 1993, using a decomposition methodology pioneered by Katz and Murphy (1992) and Bound and Johnson (1992) to understand the rising college premium in the USA.

The Supply-Demand-Institutions (SDI) framework (see Katz and Autor 1999) divides the entire workforce into imperfectly substitutable demographic groups, e.g., by gender, education, and age. Wage changes for a group can then be decomposed into supply shifts (changing group employment shares), demand shifts (changing industrial composition biased for or against a group), and wage-premia shifts (essentially, movements into or out of structurally low-paying jobs). Supply shifts are driven by such factors as changes in access to education and migration, demand shifts by factors such as skill-biased technical change and product market changes (e.g., due to globalization), and wage-premia shifts by factors such as changes in market or legal institutions.[2]

In the case of India, it is important to recognize that rural and urban labor markets are largely distinct or at least are far from being perfectly integrated (e.g., Munshi and Rosenzweig 2016). Thus, one point of departure from conventional SDI is to cut the data along the rural-urban divide, allowing us to investigate changes in wages of the rural unskilled *relative* to their urban counterparts. A second point of departure is to apply SDI at a disaggregated level, treating each Indian state (or group of states) as having separate urban and rural labor markets. A state-level approach provides the requisite degrees of freedom for econometric analysis (see Juhn and Kim 1999, for a related study of US states). We are thus able to investigate the key state-level drivers of recent relative wage trends; in other words, which types of supply or demand shifts were particularly influential in explaining the changing wage structure in India over the last decade.[3]

There is a modest literature exploring India's wage structure using data from National Sample Survey (NSS)'s Employment-Unemployment surveys. (Hnatkovska, V., & Lahiri, A: Structural transformation and the rural-urban divide, unpublished) consider rural-urban wage convergence in India from 1983 to 2009 using a model of long-run structural transformation, but they do not decompose supply and demand factors behind the more recent wage trends. While Chamarbagwala (2006), like us, uses a supply-demand decomposition, it considers the impact of trade liberalization over the earlier 1983–1999 period. Finally, both Kijima (2006) and Azam (2010) study wage inequality in urban India during the 1980s and 1990s. What distinguished our work, therefore, is the focus on changes in labor supply and demand in *both* urban and rural India over the recent and unprecedented period of rapid poverty reduction.

The organization of the paper is as follows. We begin in Section 2 by defining our groups and industries and then documenting how real and relative wages in India have changed over the past two decades. In Section 3, we review the SDI framework and apply it to the national level. Next, we turn to the state-level SDI analysis in Sections 4 and 5, followed by conclusions in Section 6.

2 Preliminaries

2.1 Definitions: groups and industries

We analyze three rounds of the NSS, the 50th (1993–1994), 61st (2004–2005), and 68th (2011–2012), thus covering an 18-year span. Workers between 12 and 65 years of age are divided into eight demographic groups, consisting of the $2 \times 2 \times 2$ interaction of male/female, educated (completed secondary level or above)/uneducated (less than completed secondary), and young (12–29)/old (30–65). In addition, we construct aggregates for these eight demographic groups by sector (urban/rural), yielding 16 groups in total.[4]

Wage earners are defined as those engaged in "gainful activities," as recorded in their "usual principal status" in the NSS, but not self-employed. The usual principal status also serves as our basis for categorizing individuals into industry groups below. We focus on principal status because this accounts for the preponderance of the reference period of 365 days preceding the date of survey.[5]

Figure 1 shows the representation of each demographic group among sector-specific wage earners. The proportion of uneducated young males and females fell across the board from 1993 to 2012, but the decline was more pronounced in rural than in urban areas (5 versus 3 percentage points for males and 6 versus 2 percentage points for females). Among the older cohorts, the proportion of uneducated also declined but

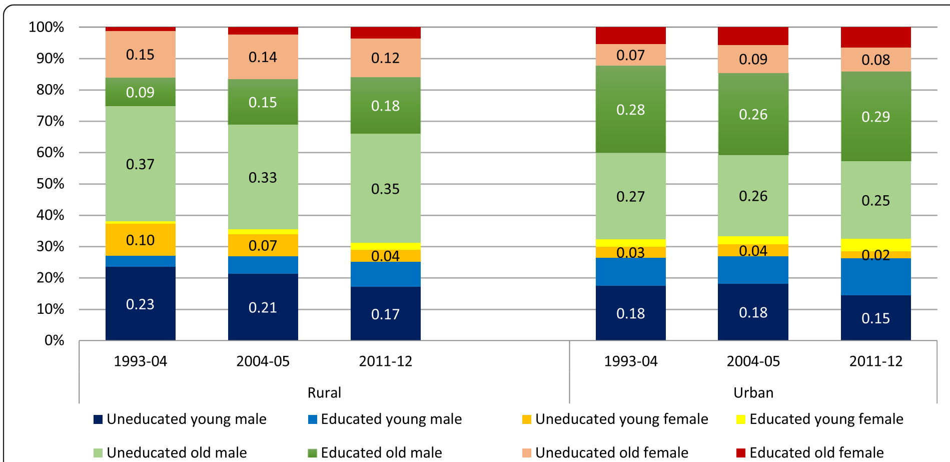

Fig. 1 Relative shares of demographic groups among wage earners

more gradually. Of course, the flip side has been the increasing share of educated among wage earners, especially in rural areas. Despite these trends, uneducated males still make up a little more than half of the workforce in rural wage labor markets.

We next define five broad "industry" or occupational categories: (1) agriculture (inclusive of forestry and fishery); (2) construction; (3) manufacturing (inclusive of mining and utilities); (4) professional (including, inter alia, financial, public administration, education, and health); (5) services (inclusive of wholesale/retail trade and domestic service).[6] SDI analyses using developed country data, and even Chamarbagwala's (2006) study of urban Indian wages, typically use a much more fine-grained industrial classification. However, sample size considerations constrain us to only five. Rural India is predominately agricultural; manufacturing has, until very recently, accounted for much less than 10% of rural employment. Given the typical NSS sample, there would simply not be enough wage earners in each category to support a very detailed classification. This concern is only reinforced in our state-level analysis, where state-wise wage-earner samples are much smaller.

Patterns of industrial employment have changed rather dramatically in rural India over the past two decades. As seen in Fig. 2, from around three quarters in the early 1990s, the share of rural labor employed in agriculture had, by 2011, declined to around one half. The two main rural growth industries are services and construction, with the latter's employment share more than quadrupling (from 3 to 13%) over the last two decades, a finding consistent with anecdotal reports of India's rural construction "boom." By contrast, the urban picture is one of relative stasis, with more modest expansions of services and construction over the same period.[7]

Representation of the eight demographic groups in each industry is shown for both rural and urban areas in Fig. 3. Educated workers, obviously, predominate in the professions, whereas wage jobs in rural construction are largely held by unskilled males, even more so than in agriculture and quite substantially more so than in services. Looking at trends by industry over the past two decades, Fig. 3 shows (with 2004–2005 omitted for brevity) a gradual up-skilling of the workforce across the board. Between 1993–1994 and 2011–2012, the share of rural uneducated young males and females in

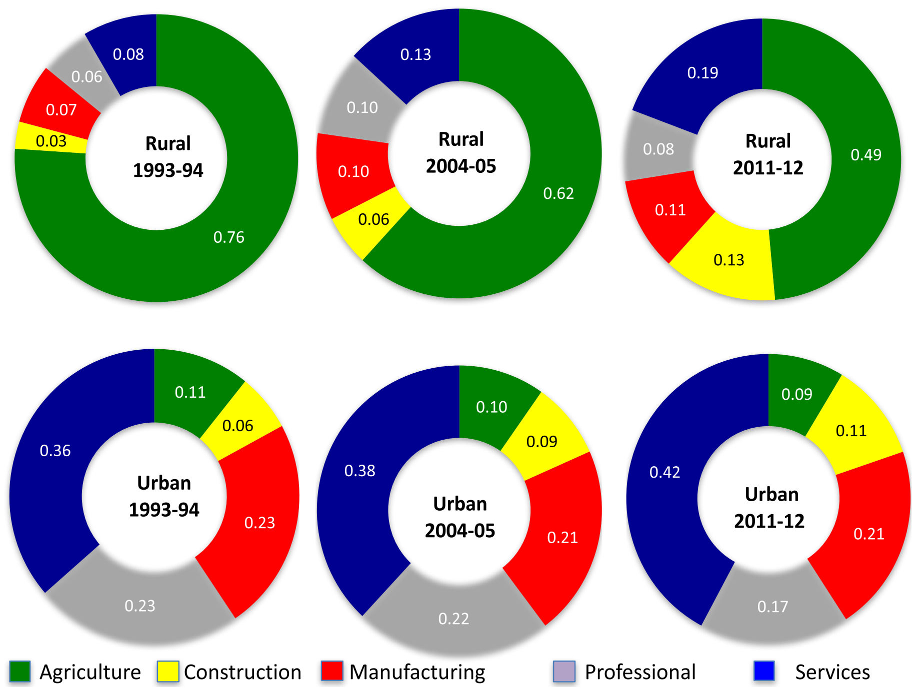

Fig. 2 Share of industries in rural-urban employment

agriculture fell by half, from 23 to 12% for males and from 11 to 6% for females. In rural construction, however, while the share of uneducated young females declined by 10 percentage points, that of young uneducated males remained virtually unchanged. Meanwhile, the share of educated young males nearly doubled in both rural manufacturing and in services over this period but stayed around 11% in professional jobs. Even more dramatic increases in industry employment shares between 1993–1994 and 2011–2012 occurred for older educated males, both in rural and urban areas. For educated women, by contrast, the employment share has only increased significantly in professional jobs.

2.2 Changes in real wages

Information on weekly wage earnings and days worked per week is available for regular and casual workers. In the case of those who perform multiple jobs in the week, we calculate average daily wages by dividing weekly wage income from all sources by total number of days worked. To compute real wages, we use the state-level Consumer Price Index for Agriculture (CPI-AL) and Industrial Workers (CPI-IW). Originally, the CPI-AL was available with base year 1986–1987 and CPI-IW with base year 1982. We converted these indices to have a uniform base year 2004–2005. CPI-AL is used to deflate wages in rural areas and CPI-IW in urban India. Because these deflators are not available for some of the small states, we used available information for larger states either adjacent to them or from which they had been split (see Table 5 in Appendix for details on the CPI calculation for the smaller states).

Mean *annualized* changes in log real wages by group are shown in Fig. 4 across each of the two sub-periods. Evidently, wages have been rising in real terms over the past two decades for all groups and especially in rural areas. There has also been a marked

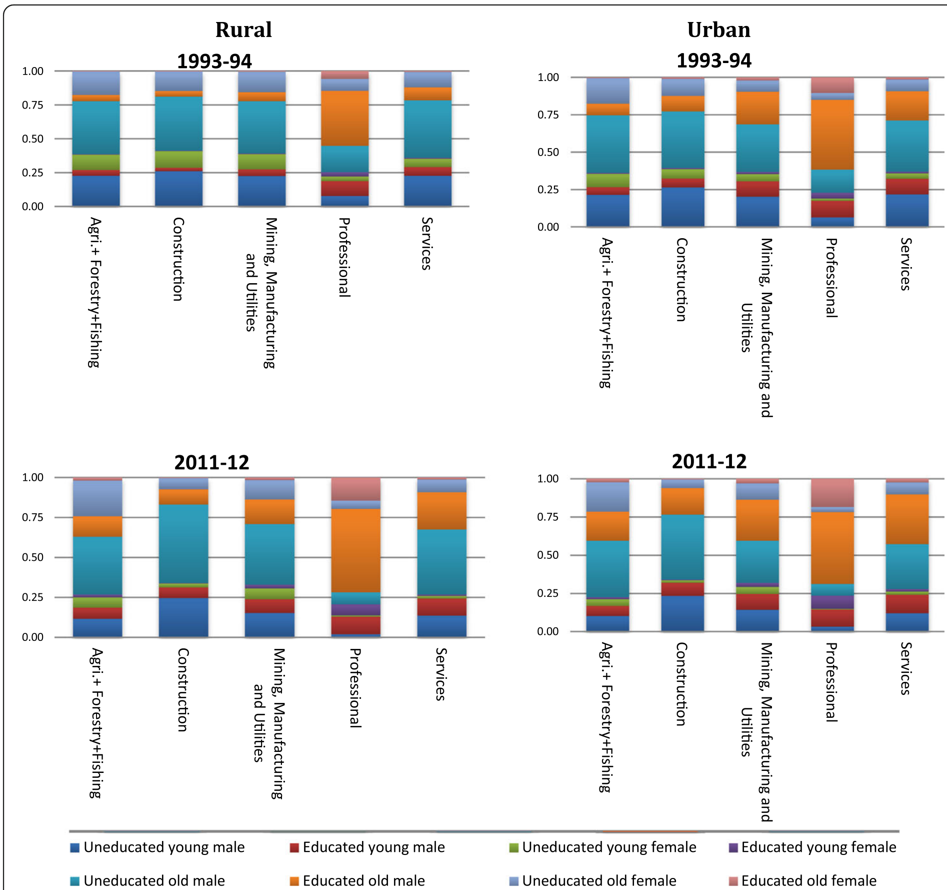

Fig. 3 Share of demographic group in each industry

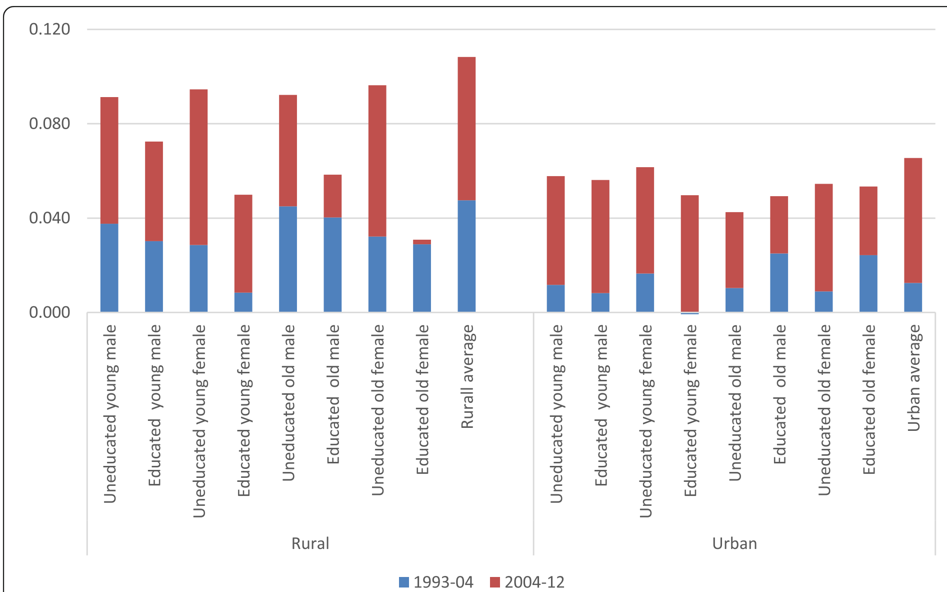

Fig. 4 Annual average real wage changes by demographic group

acceleration in wage growth in recent years, most pronounced in urban India as well as among the unskilled (those with less than secondary education). Looking across states (Fig. 5), we see big real-wage gains for unskilled workers in the south and east of the country, with W. Bengal being a notable exception. The remainder of our analysis will largely ignore this overall rising tide to focus on why some "boats" have risen faster than others.

2.3 Changes in relative wages within and across sectors

For ease of presentation under the first major column heading of Table 1, we aggregate mean relative wage changes across pairs of demographic groups using the respective (base year) shares of wage earners as weights. Thus, for example, the change in the wage for rural educated males relative to rural uneducated males is computed as a weighted average of the corresponding mean wage changes for old and young rural males in each of these educational categories.

The first three columns of Table 1 report relative wage trends denominated in log changes. Rows 1 and 2 indicate that the wages of uneducated rural workers *rose* relative to those of educated rural workers (hence the negative sign) for both males and females. Specifically, unskilled men (women) saw their wages rise by 33 (41) % relative to skilled men (women) since the early 1990s. Much of these relative gains occurred in the most recent decade (2004–2011). Note that the urban unskilled also experienced relative wage gains in the second period, but not quite as much as their rural counterparts. Overall, rural females (especially the unskilled) gained ground on rural males in the last decade.

Looking across the urban-rural divide in Table 2, the striking pattern is wage convergence, albeit skewed toward the unskilled. Overall, wages for uneducated males rose by around 47% relative to their urban counterparts; the corresponding figure for uneducated females is 37%. However, much of these gains occurred in the earlier decade of the post-reform era, especially for males. Similar, but substantially smaller, relative gains were experienced by educated rural workers. Aggregating across groups, rural wages rose a modest 9% relative to urban wages over the last decade, following a 27% increase in the first decade.

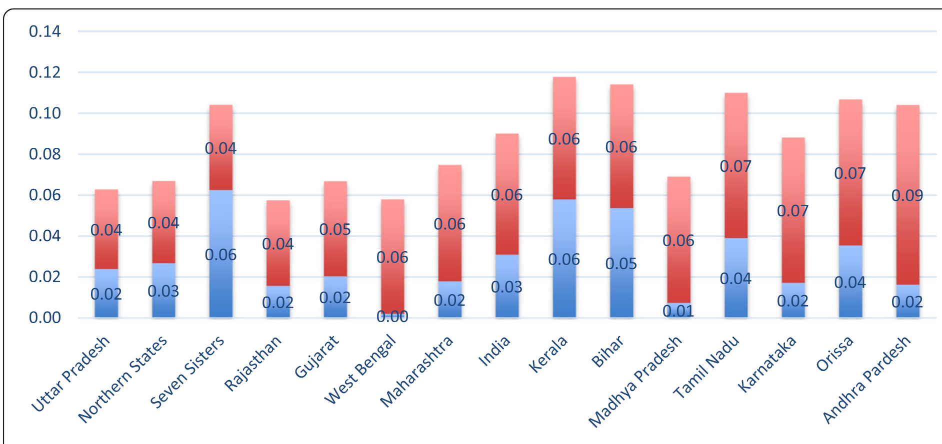

Fig. 5 Annual average growth rate in real wage for unskilled labor by state

Table 1 SDI decomposition of relative wage changes within rural and urban India

		Relative wage			Relative supply			Relative demand			Institutions		
		1993–1994 to 2004–2005	2004–2005 to 2011–2012	1993–1994 to 2011–2012	1993–1994 to 2004–2005	2004–2005 to 2011–2012	1993–1994 to 2011–2012	1993–1994 to 2004–2005	2004–2005 to 2011–2012	1993–1994 to 2011–2012	1993–1994 to 2004–2005	2004–2005 to 2011–2012	1993–1994 to 2011–2012
Rural													
Educated/uneducated	Male	− 0.09	− 0.24	− 0.33	0.50	0.41	0.91	− 0.29	− 0.37	− 0.64	− 0.08	0.03	− 0.01
	Female	− 0.10	− 0.31	− 0.41	0.82	0.70	1.51	− 0.15	− 0.03	− 0.27	− 0.07	− 0.08	− 0.09
Old/young	Male	0.10	− 0.06	0.04	0.11	0.30	0.41	0.25	0.11	0.38	0.00	− 0.07	− 0.07
	Female	0.05	− 0.03	0.02	0.37	0.38	0.75	0.07	0.00	0.09	− 0.06	0.04	− 0.02
Male/female		0.13	− 0.15	− 0.01	− 0.06	0.34	0.28	0.28	0.31	0.47	0.41	− 0.13	0.11
Urban													
Educated/uneducated	Male	0.11	− 0.13	− 0.03	0.07	0.32	0.38	− 0.06	− 0.11	− 0.17	− 0.22	0.01	− 0.15
	Female	0.04	− 0.17	− 0.13	− 0.03	0.43	0.40	− 0.01	− 0.02	− 0.04	− 0.23	− 0.05	− 0.19
Old/young	Male	0.10	− 0.16	− 0.06	0.07	0.24	0.32	0.00	− 0.05	− 0.05	− 0.14	− 0.08	− 0.19
	Female	0.01	− 0.16	− 0.15	0.13	0.12	0.25	0.00	− 0.01	0.00	− 0.13	− 0.02	− 0.12
Male/female		0.03	− 0.14	− 0.11	−0.17	0.15	− 0.02	0.02	0.02	0.02	0.25	− 0.07	0.05

Table 2 SDI decomposition of relative wage changes between rural and urban India

		Relative wage			Relative supply			Relative demand			Institutions		
		1993–1994 to 2004–2005	2004–2005 to 2011–2012	1993–1994 to 2011–2012	1993–1994 to 2004–2005	2004–2005 to 2011–2012	1993–1994 to 2011–2012	1993–1994 to 2004–2005	2004–2005 to 2011–2012	1993–1994 to 2011–2012	1993–1994 to 2004–2005	2004–2005 to 2011–2012	1993–1994 to 2011–2012
Urban/rural educ.	Male	− 0.17	0.01	− 0.16	− 0.38	− 0.20	− 0.57	− 0.22	− 0.11	− 0.30	− 0.21	− 0.12	− 0.26
	Female	− 0.07	− 0.02	− 0.09	− 0.73	− 0.25	− 0.99	− 0.03	− 0.02	− 0.05	− 0.08	− 0.12	− 0.18
Urban/rural uneduc.	Male	− 0.37	− 0.10	− 0.47	0.05	− 0.10	− 0.05	− 0.45	− 0.37	− 0.77	− 0.07	− 0.10	− 0.13
	Female	− 0.21	− 0.16	− 0.37	0.12	0.01	0.13	− 0.17	− 0.04	− 0.28	0.08	− 0.15	− 0.08
Urban/rural old	Male	− 0.29	− 0.09	− 0.38	0.06	0.01	0.07	− 0.52	− 0.37	− 0.89	− 0.19	− 0.10	− 0.22
	Female	− 0.16	− 0.12	− 0.29	0.05	0.14	0.19	− 0.19	− 0.04	− 0.32	0.00	− 0.17	− 0.16
Urban/rural young	Male	− 0.28	0.00	− 0.28	0.10	0.07	0.16	− 0.27	− 0.22	− 0.46	− 0.06	− 0.09	− 0.11
	Female	− 0.12	0.00	− 0.12	0.29	0.40	0.69	− 0.13	− 0.03	− 0.23	0.06	− 0.12	− 0.06
Urban/rural	Male	− 0.35	− 0.08	− 0.44	0.09	0.00	0.09	− 0.43	− 0.32	− 0.73	− 0.15	− 0.10	− 0.19
	Female	− 0.25	− 0.09	− 0.34	0.20	0.19	0.39	− 0.17	− 0.04	− 0.28	0.01	− 0.16	− 0.13
Urban/rural	All	− 0.27	− 0.09	− 0.36	0.28	0.20	0.48	− 0.35	− 0.24	− 0.60	− 0.08	− 0.12	− 0.17

3 Supply, demand, institutions

3.1 Conceptual framework

Suppose we have a CES production function for aggregate output that depends on just two types of labor (ignore capital), types a and b. Katz and Autor (1999), e.g., show that

$$\log\left(\frac{w_{at}}{w_{bt}}\right) = \frac{1}{\sigma}\left[D_t - S_t\right], \tag{1}$$

where w_{it} are wages for type i in time t, D_t is an index of relative demand shifts favoring group a, and S_t is an index of relative supply shifts favoring group a. The parameter σ represents the aggregate elasticity of substitution in production between labor of type a and b.[8] A key implication of the model is that only *net* demand shifts (i.e., net of supply shifts) matter for relative wages. Differencing Eq. (1) over time, using the notation $\Delta x_t = x_t - x_{t-l}$, delivers

$$\Delta \log\left(\frac{w_{at}}{w_{bt}}\right) = \frac{1}{\sigma}\left[\Delta D_t - \Delta S_t\right]. \tag{2}$$

Thus, on the left-hand side of Eq. (2), we have a difference-in-differences in mean log wage for two groups over time.[9] These diff-in-diffs are precisely what is reported in Tables 1 and 2 for, respectively, within and between sector contrasts.

We may write the relative supply for group i in sector s at time t as

$$S_{ist} = \log\left(\frac{N_{ist}}{N_{st}}\right) \tag{3}$$

where N_{ist} is the group's employment in the sector and N_{st} is total employment in the sector. So, for example, the relative supply of uneducated young males in rural areas is the log ratio of the number of uneducated young males to total number of workers employed in rural areas. Note that employment includes self-employment in agriculture or in a household enterprise and hence the employed are a much larger set than wage earners, especially in the rural sector. Shifts in supply, ΔS_{ist}, are assumed predetermined; that is, not *caused* by changes in relative wages. In the state-level analysis, we will have the opportunity to test this assumption.

Theoretically consistent measurement of demand shifts is a complicated issue (see Katz and Autor, 1999; Bound and Johnson, 1992). We follow Juhn and Kim (1999), who use the between (industrial) sector demand shift measure of Katz and Murphy (1992),[10]

$$\Delta D_{ist} = \sum\nolimits_k \frac{N_{ikst}}{N_{kst}} \Delta \log\left(\frac{N_{kst}}{N_{st}}\right) \tag{4}$$

where k indexes industry. So, the first term in the sum is the share of demographic group i in industry k's employment (e.g., share of young unskilled men in agriculture) and the second term is the growth rate in the share of industry k employment in overall sectoral employment (e.g., growth in agriculture as a share of rural employment). Intuitively, ΔD_{ist} is larger when demographic group i (initially) predominates in relatively fast-growing industries. As with supply shifts, ΔD_{ist} is taken as exogenous with respect to changes in relative wage structure; once again, this is testable.

The "institutions" component of SDI boils down to allowing for industry wage premia. A wage premium measures the extent to which a given type of worker (demographic group) is paid more (or less) when working in a particular industry. Labor market institutions matter insofar as wages are not determined solely by the interaction of skill endowments and skill prices—i.e., by the competitive market for skills. A salient example in the case of India is agricultural labor. On average, jobs in agriculture pay around a third less than those outside of agriculture, holding location and type of worker constant (see Table 6 in Appendix for estimates of industry dummy variable coefficients from standard log-wage regressions).[11]

Following Bound and Johnson (1992), then let

$$\log(W_{ist}) = \log\left(W^{c}_{ist}\right) + \sum\nolimits_{k} \rho_{iskt}\phi_{iskt} \tag{5}$$

where W^{c}_{ist} is the competitive market wage given group i skills, ρ_{iskt} is the industry k wage premium for group i at time t, and $\phi_{iskt} = N_{iskt}/N_{ist}$ is the proportion of group i workers in industry k. Based on ρ_{iskt} estimated from wage regressions, the institutions index (ΔI) for group i is the *change* in the entire wage-premium term or

$$\Delta I_{ist} = \sum\nolimits_{k} \left[\Delta\rho_{iskt}\phi_{iskt-l} + \rho_{iskt-l}\Delta\phi_{iskt}\right] \tag{6}$$

Returning to the case of India's agricultural sector, we can see that groups with a high value of ΔI_{ist} have to be moving out of agriculture relatively quickly. This is because ρ_{iskt-l} is large and negative (e.g., − 0.22 in 1993–1994), whereas $\Delta\rho_{iskt}$ is rather small (− 0.05 = − 0.27 + 0.22 from 1993–1994 to 2011–2012; see Table 6 in Appendix). Comparison of group shares across NSS rounds, as shown in Fig. 6, indicates that uneducated rural males (young and old) are shifting out of agriculture most rapidly.

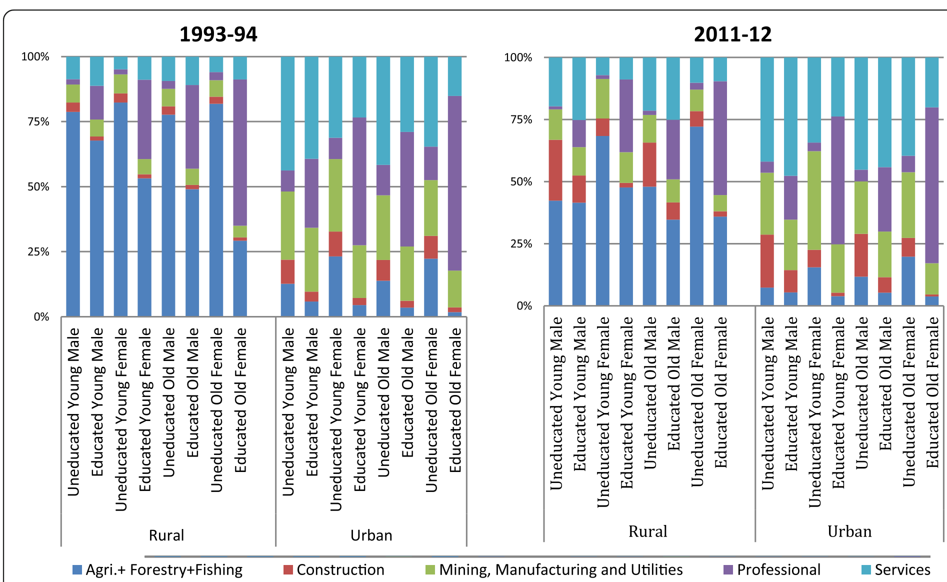

Fig. 6 Industry share of employment by demographic group

3.2 All-India decomposition

SDI metrics at the national level are reported under, respectively, the second, third, and fourth major column headings of Table 1. So, why did the wages of educated workers decline *relative* to the wages of uneducated workers in rural India? First off, there was a substantial increase in relative supply of educated workers spread rather evenly across the two sub-periods. Thus, we see that the relative supply of educated men rose by 0.50 log points (or 50%) from 1993–1994 to 2004–2005 and again by 0.41 log points from 2004–2005 to 2011–2012; the corresponding figures for educated women are 0.82 and 0.70, respectively. Meanwhile, relative demand for educated workers fell, especially for males (by 0.29 log points in the earlier period and 0.37 log points in the later period). And, finally, there were modest declines in the institutions index for educated relative to uneducated workers. In other words, uneducated workers moved out of (low-paid) agricultural labor faster than educated workers. Similar, but less pronounced, patterns are seen for educated vs. uneducated workers in urban India (rows 6 and 7).

In Table 2, we compute urban vs. rural SDI changes. Focusing on unskilled labor (rows 2 and 3), we see that shifts in relative supply were not a decisive factor behind the wage gains of uneducated workers vis-a-vis the educated. For example, the supply of urban educated males fell by only 0.05 log points over the last two decades relative to that of rural educated males; the corresponding figure for females indicates a *rise* in relative supply of 0.13 log points. There were, however, big drops in relative demand for unskilled male labor in urban areas (0.77 log points over the 1993–1994 to 2011–2012 period), with smaller declines in the case of females (0.28 log points). The institutions index also moved slightly against the urban unskilled. The story of wage gains by the rural unskilled relative to their urban counterparts is, therefore, one of changing patterns of industrial employment rather than one of changing relative supplies (as was the case within the rural sector).

4 State-level SDI analysis

We now compute changes in mean log wages, ΔS_{ist}, ΔD_{ist}, and ΔI_{ist} separately for each major state or group of adjacent states.[12] Our "data set," therefore, consists of 448 = 2 × 2 × 8 × 14 observations for 2 decadal intervals, 2 sectors (rural/urban), 8 demographic groups, and 14 states. Note that in treating a state as, for all intents and purposes, a distinct labor market, we are assuming that changes in, say, labor supply within a given state are not driven by inter-state migration. This assumption seems reasonable as a first approximation given India's historically low mobility (see Hnatkovska, V., & Lahiri, A: Structural transformation and the rural-urban divide, unpublished).

Bivariate scatterplots (Fig. 7) reveal that increases in supply are strongly associated with wage declines in each period. Increases in demand, by contrast, are associated with wage increases (Fig. 8). This is all as it should be, but to properly assess the SDI framework, we need to control for both supply and demand shifts simultaneously. To do so, we run a series of regressions of state mean log-wage changes on the SDI shift variables. The first such regression, shown in Table 3, uses the full dataset, thus including log-wage changes between 1993–2004 and 2004–2011. Among the independent variables is a dummy for the second decadal change. Results in the first column of Table 3 show that increases in supply lead to lower wages, conditional on the demand shift. Likewise, increases in demand increase wages, conditional on the supply shift. Moreover, we cannot reject the null

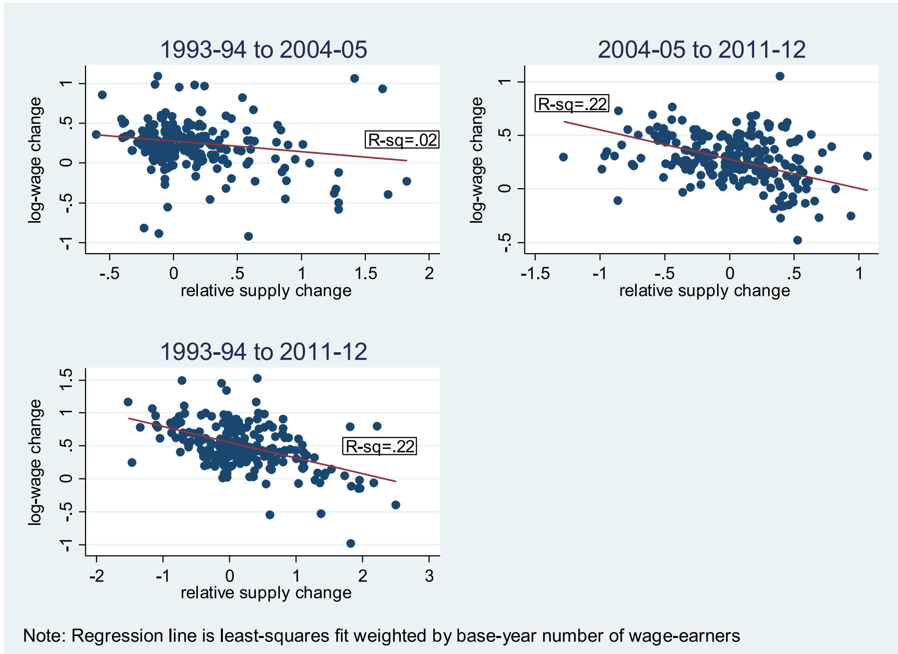

Fig. 7 Bivariate relationship between state/group wage changes and supply shifts

hypothesis that the coefficient on supply is equal to minus the coefficient on demand, i.e., that only net demand shifts matter for wages (cf., Eq. (1)).

Next, we address the simultaneity between wage changes on the one hand and demand and/or supply shifts on the other. Do ΔS_{ist}, ΔD_{ist}, and, for that matter, ΔI_{ist} *cause* wages to change, or is it the other way around? Arguably, the supply of skills and the

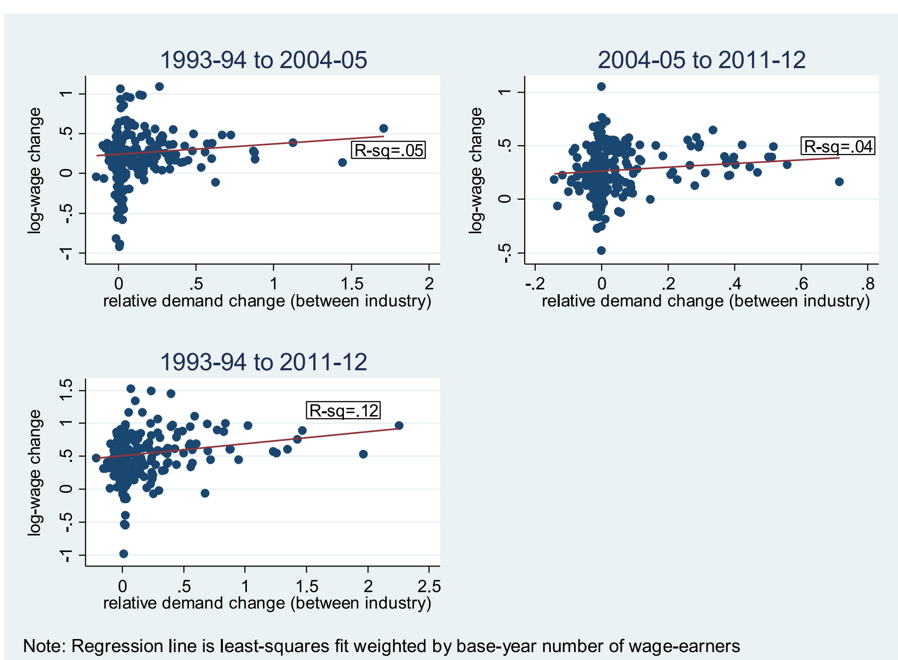

Fig. 8 Bivariate relationship between state/group wage changes and demand shifts

Table 3 Regression analysis

Variables	2004/2005–2011/2012 only			
	(1)	(2)	(3)	(4)
	OLS	OLS	IV	IV
ΔSupply	− 0.218***	− 0.262***	− 0.294***	
	(0.031)	(0.037)	(0.039)	
ΔDemand	0.120**	0.137	0.335***	
	(0.054)	(0.112)	(0.091)	
Δ(Demand − Supply)				0.312***
				(0.042)
Industry effect	− 0.011	0.054	0.028	0.031
	(0.047)	(0.054)	(0.138)	(0.131)
ΔSupply = −ΔDemand (*p* value)	0.18	0.35	0.71	
Year FE	Y	N	N	N
Observations	448	224	224	224
R-squared	0.132	0.251	0.196	0.202

Notes: Robust standard errors in parentheses clustered on state (***$p < 0.01$, **$p < 0.05$, *$p < 0.1$). Dependent variable in all regression is mean log wage change of demographic group in state

structure of industrial employment are slow to adjust and may reasonably be thought of as predetermined. However, to test this proposition, we instrument ΔS_{ist}, ΔD_{ist}, and ΔI_{ist} by their lagged values ΔS_{ist-l}, ΔD_{ist-l}, and ΔI_{ist-l}. The idea here is that lagged changes reflect long-run trends, uncontaminated by contemporaneous wage shocks. Of course, using lags as instruments requires us to drop the first decadal change, which corresponds to half our sample. Hence, in column 2, we replicate our original OLS specification on the sample of second-decadal changes, with very similar results. IV estimates are shown in column 3. There is little evidence of endogeneity bias; to be sure, the coefficient on demand shifts more than doubles from its OLS magnitude, but this could be due to chance. And the null hypothesis of the SDI framework fares extremely well in this specification. Thus, in column (4), we report the same IV specification but with the SDI restriction imposed, which is to say that only *net* demand shifts $\Delta D_{ist} - \Delta S_{ist}$ are now included along with ΔI_{ist}. The estimated coefficient on the former variable implies that a net demand shift of 1.0 log points translates into a relative wage change of 0.312 log points. Finally, in all specifications, the coefficient on the institutions index ΔI_{ist} is not significantly different from zero.[13]

5 SDI drivers across states

The diagnostics of the previous section suggest that the SDI framework does a reasonably good job explaining wage growth of the past decade across both demographic groups and states. But what are the key structural trends underlying these changes? Five candidates for consideration are as follows: (1) urbanization, (2) National Rural Employment Guarantee Act (NREGA), (3) the rural construction "boom," (4) falling rural female labor force participation (LFP), and (5) rising agricultural prices.

We begin by predicting log-wage changes from 2004 to 2011 for each group × state observation using the results in Table 3, column 4, i.e.,

$$\Delta \log\widehat{(W_{ist})} = \hat{\beta}_0 + \hat{\beta}_1(\Delta D_{ist} - \Delta S_{ist}) + \hat{\beta}_2 \Delta I_{ist}. \tag{7}$$

Next, we construct predicted difference-in-differences across groups i and j within a sector as follows

$$\Delta_{ij}\,\widehat{\Delta\log(W_{st})} = \widehat{\Delta\log(W_{ist})} - \widehat{\Delta\log(W_{jst})} \tag{8}$$

or across sectors within group i using

$$\Delta_{ur}\,\widehat{\Delta\log(W_{it})} = \widehat{\Delta\log(W_{iut})} - \widehat{\Delta\log(W_{irt})}, \tag{9}$$

where subscripts u and r denote, respectively, urban and rural. Finally, we examine the bivariate associations between the predicted diff-in-diffs and each of the five structural wage drivers mentioned above.

5.1 Within rural India

We look first at rural areas and, in particular, at wages of educated rural workers (old/young and male/female taken together) relative to uneducated. Each panel of Fig. 9 shows a scatterplot of $\Delta_{\text{ed,uned}}\,\widehat{\Delta\log(W_{rt})}$against a relevant driver. Having now aggregated wage changes across all eight demographic groups, we end up with 14 data points, which is to say one $\Delta_{\text{ed,uned}}\,\widehat{\Delta\log(W_{rt})}$for each state group.

Consider the change in the employment share of construction in rural areas of each of the 14 state groups. The top left panel of Fig. 9 shows that higher construction

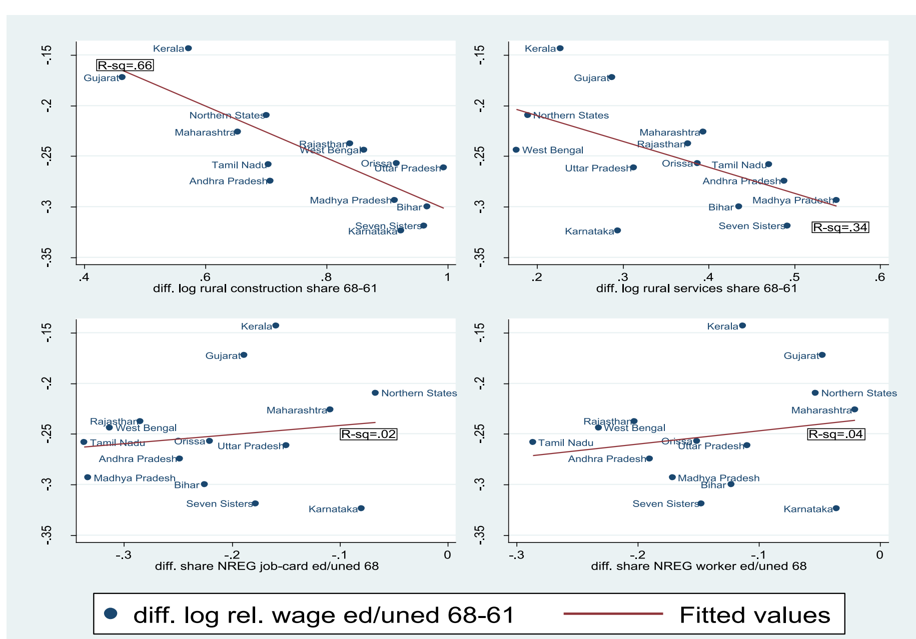

Fig. 9 Drivers of changes in educated vs. uneducated wages within rural India

shares are strongly positively associated with the predicted growth in wages for the *uneducated* relative to *educated*. Indeed, differences in construction industry growth explain about two thirds of the variation in the relative wage growth predicted by the SDI framework. The same exercise using the rural services share, an industry which also employs significant numbers of unskilled workers and which also expanded in relative terms over the last decade, shows a similar pattern but a weaker association with wages. In sum, the rural construction boom appears to have been an important, if not the main, driver of unskilled relative wage growth within rural India.

It is interesting to contrast the labor market impacts of the above compositional shifts to those of National Rural Employment Guarantee (NREG). Phase-in of NREG began at around the mid-point of our 2004–2011 window. Analyses of NSS data preceding the 68th (2011–2012) round provide mixed evidence as to the rural wage impacts of NREG expansion (see Azam 2012; Zimmermann, L: Why guarantee employment? Evidence from a large Indian public-works program, unpublished; Imbert and Papp 2015). However, NSS68, for the first time, provides *individual* level data on NREG registration (job-card holding) and take-up (i.e., NREG employment in the last 12 months). This allows us to construct, for each state, the proportion of each demographic group that are job-card holders or who have worked in NREG.

Looking across state groups in Fig. 10, there are huge differences in NREG registration rates, with Rajasthan and MP topping the list, although rates of participation in this massive public works program are actually highest in the far east of India ("Seven Sister" states). Also relevant for our analysis is the large registration and participation gap between the educated and uneducated, with much higher NREG involvement among the latter (Fig. 11). Thus, we have in the two bottom panels of Fig. 9 plots of the predicted log-wage diff-in-diffs against the state-wise differences in NREG participation shares (job card on the left; worker on the right) between educated and uneducated groups. Given Fig. 11, all of the NREG share differences are negative (educated have lower registration and take-up than uneducated). What we do not see is much of a relationship between NREG participation and wage growth (the slopes are positive, but the R^2's are essentially zero). Put differently, states in which NREG has (presumably) expanded relative employment opportunities for unskilled labor more do not appear to have experienced differential growth in net demand for unskilled labor. This is, of course, not to say that NREG has

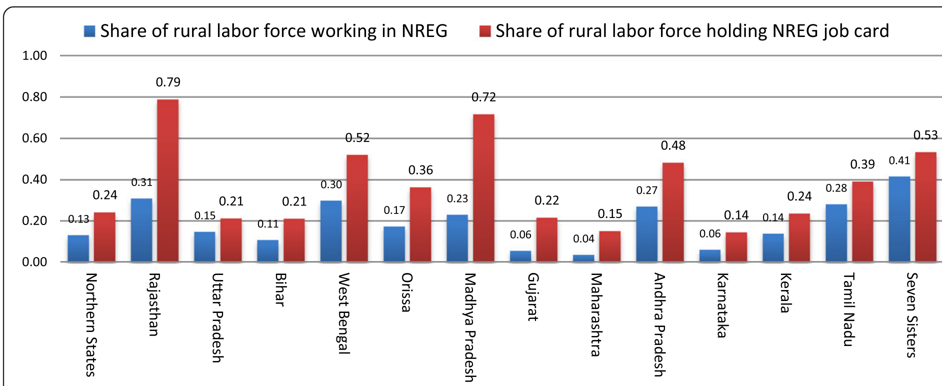

Fig. 10 State-wise NREG participation in rural India, 2011–2012

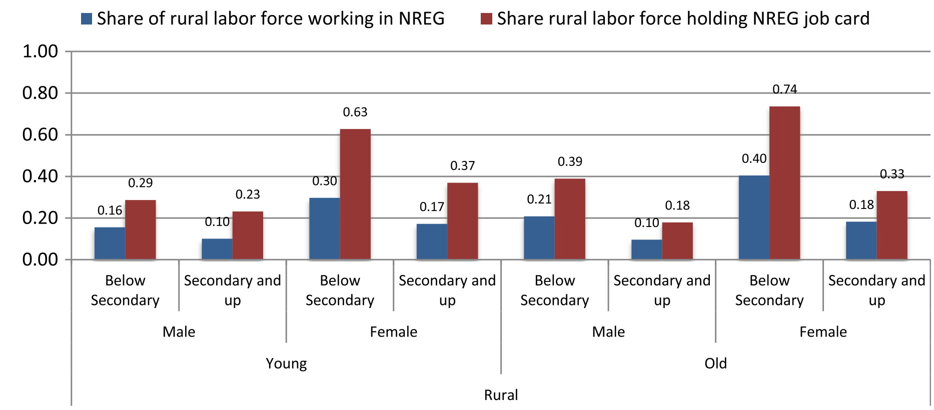

Fig. 11 Group-wise NREG participation in rural India, 2011–2012

been ineffectual as a safety net for the poor, only that it is evidently too small of a labor market intervention to have detectable general equilibrium effects.[14]

Next, using the same approach, we consider what has been driving changes in relative wages of men vs. women in rural India over the last decade. In this case, we compute $\Delta_{m,f}\widehat{\Delta\log}(W_{rt})$by aggregating wage changes for all male (m) and female (f) demographic groups within the rural sector of each state. Here, we introduce another potentially relevant factor, the change in female LFP rate, which counts as labor force participants the self-employed, regular, and casual wage earners, as well as the unemployed seeking jobs. Figure 12 shows massive declines in female LFP in rural areas of most states, whereas Fig. 13 shows much more muted ones in the corresponding urban areas.

The top left panel of Fig. 14 provides striking confirmation that this recent movement of women out of the rural labor force explains much of the predicted *increase* in their wages relative to those of men; the R^2 of the associated bivariate regression is 0.84. By contrast, changes in the rural construction share (top right panel) or in women's participation in NREG relative to men's (bottom panels) explain next to nothing.

5.2 Urban vs. rural India

In the remainder of our analysis, we contrast urban and rural wage changes for *unskilled* labor. In particular, we use Eq. (9) to compute $\Delta_{ur}\widehat{\Delta\log}(W_{it})$ separately for

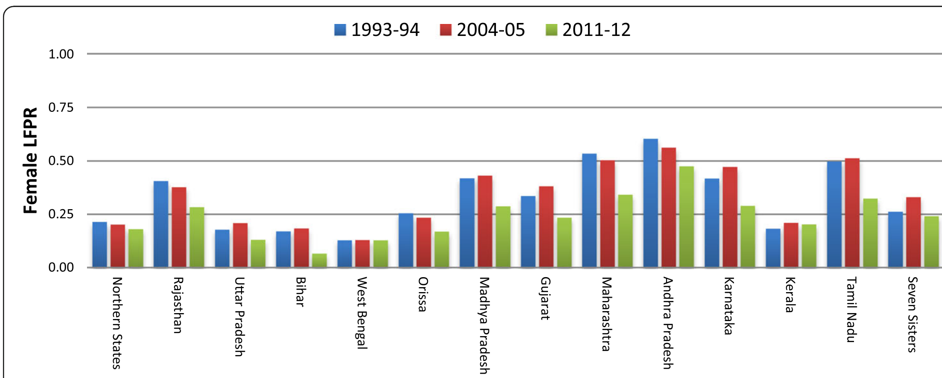

Fig. 12 Female labor force participation in rural India

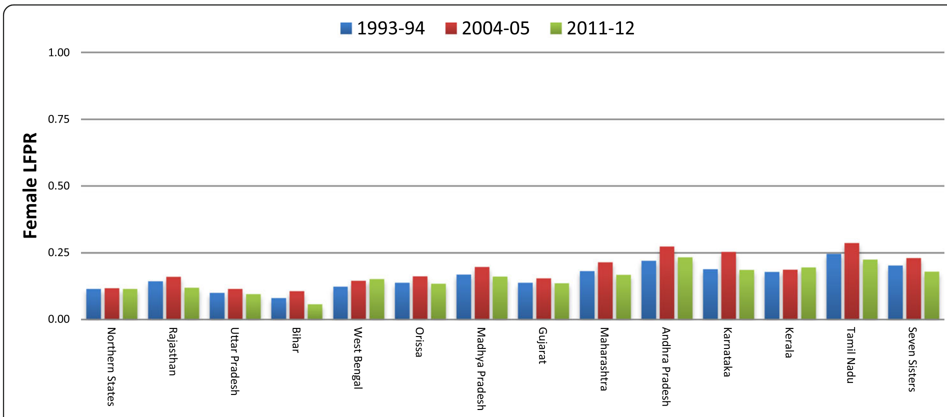

Fig. 13 Female labor force participation in urban India

uneducated males (Fig. 15) and for uneducated females (Fig. 16). On the *x*-axis in each panel in the next two figures is the urban-rural difference in log shares of construction employment (top left), services employment (top right), and female LFP (as a share of all females of working age). The bottom right panel of each of the figures considers the change in the urban (state) population share between the 2001 and 2011 population censuses (see Figure 19 in Appendix).

For males, the construction sector stands out as the key *relative* wage driver. A fall in the urban-rural construction industry share differential over time is associated with a decline in the urban-rural wage differential ($R^2 = 0.34$), whereas for females, the corresponding association is negative, albeit weak ($R^2 = 0.05$). Relative growth in the service sector, by contrast, bears little relationship to relative wage changes for either males or females. As for female LFP, we again see a strong correlation with wage growth. In states where women

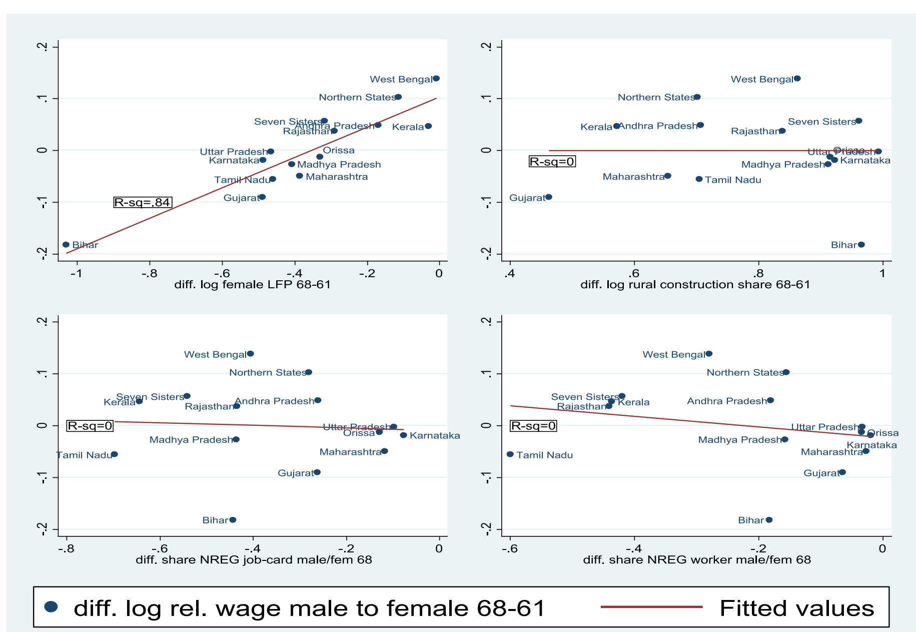

Fig. 14 Drivers of changes in male vs. female wages within rural India

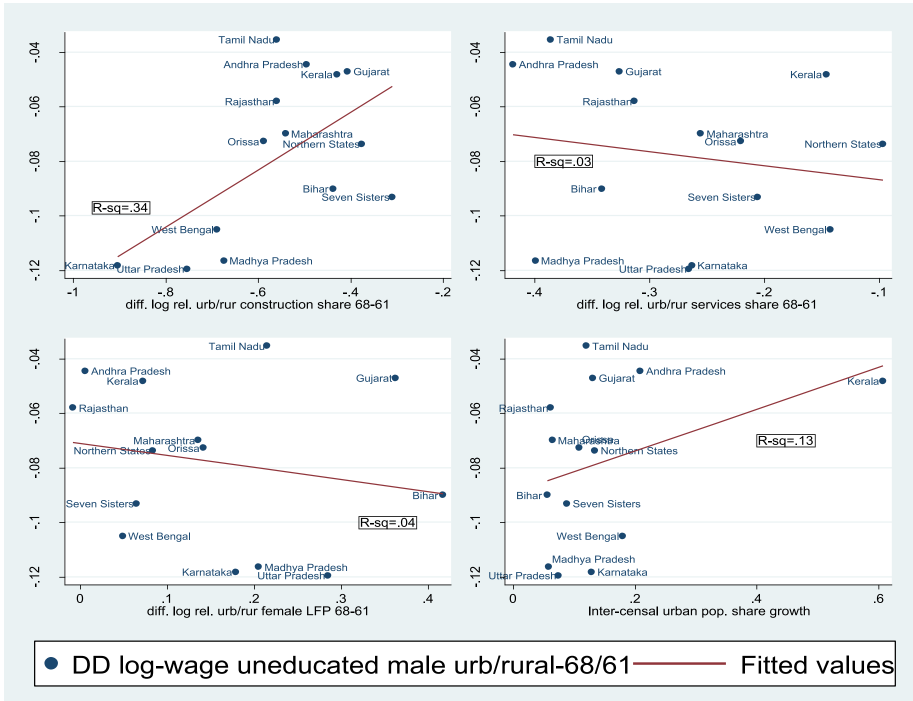

Fig. 15 Drivers of changes in urban vs. rural wages for males

have withdrawn from the labor force faster in the countryside than in cities, rural wages of females have risen faster than urban wages ($R^2 = 0.31$), a pattern essentially absent with respect to male wages ($R^2 = 0.04$).

Next, we ask whether the growth of cities has in and of itself led to changes in SDI at the state level. By far, the fastest urbanization over the last decade occurred in Kerala,

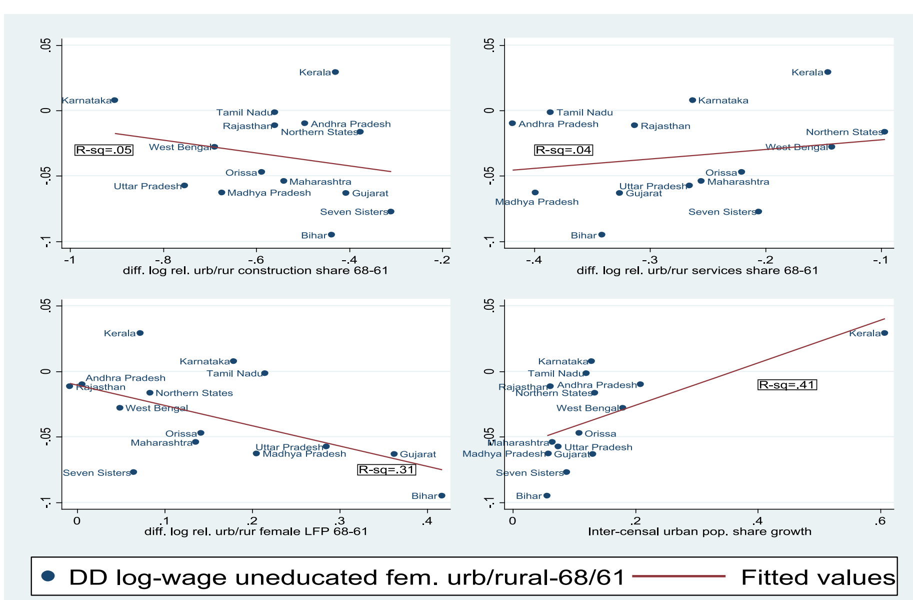

Fig. 16 Drivers of changes in urban vs. rural wages for females

which is clearly an outlier in the bottom right panels of Figs. 15 and 16. Nevertheless, even with Kerala excluded, the story is clear. Faster urbanization is associated with greater *urban* wage growth relative to rural areas for both genders, but especially for females. Moreover, this latter effect is not driven merely by correlation between falling female LFP and urbanization; it survives virtually intact after controlling for the relative change in female LFP. Thus, it appears that in rapidly urbanizing states, the demand for female labor, as reflected in their wages, has been growing faster in cities than in the countryside.

As a final exercise, we turn to the agricultural commodity price boom of recent years as an explanation for the relative rise in rural wages. Jacoby (2016) uses variation across Indian districts in the shares of different crops in production to show that districts experiencing relatively higher agricultural prices over the 2004–2009 period also saw higher wages for unskilled labor. Adapting this approach to the state-level analysis of this section and extending the price data to 2011–2012, we construct the following measure of *differential* agricultural price change

$$\Delta_{ur}\Delta P^A = \left(\beta_u^A - \beta_r^A\right)\sum\nolimits_c s_c \Delta \log p_c, \tag{10}$$

where β_j^A is the initial (i.e., 2004–2005) share of labor in agriculture for a state in sector $(j = u, r)$, s_c is the share of crop c in the total value of state agricultural production in base year 2003–2004, and $\Delta \log p_c$ is the change in log price of crop c between the 2004–2005 and 2011–2012 crop marketing years for the 18 top field crops of India.[15] Intuitively, the labor market response to changes in agricultural prices is modulated by the output share of agriculture in the overall economy of the sector; if production is Cobb-Douglas, this output share is equivalent to the labor share.

The relationship between differential urban-rural agricultural price changes, as reflected in $\Delta_{ur}\Delta P^A$, and relative wage changes, as reflected by $\Delta_{ur}\widehat{\Delta \log}(W_{it})$, is complicated by the fact that the agricultural labor share differential $\beta_u^A - \beta_r^A$ affects both quantities independently. Referring to Eqs. (4) and (7), one can see that $\beta_u^A - \beta_r^A$ and $\Delta_{ur}\widehat{\Delta \log}(W_{it})$ are mechanically related. In particular, since unskilled workers shifted out of agriculture into construction and other services over the last decade, the demand index for unskilled workers is dominated by a weighted average of the proportion of each of these industry's shares of unskilled labor, where the weights are, essentially, the growth rates of employment in the respective industries. In a state where agriculture had a larger initial employment share, the growth *rate* of agriculture employment tends to be smaller and, hence, there appears to be a greater *increase* in demand for unskilled labor. The upshot is that, in considering the bivariate relationship between $\Delta_{ur}\Delta P^A$ and $\Delta_{ur}\widehat{\Delta \log}(W_{it})$, we must partial out this mechanical correlation with $\beta_u^A - \beta_r^A$. Figure 17 thus plots the residuals of $\Delta_{ur}\widehat{\Delta \log}(W_{it})$ against those of $\Delta_{ur}\Delta P^A$ in regressions on $\beta_u^A - \beta_r^A$ across the 14 state groups. Consistent with Jacoby (2016), the figure shows that rural wages of the unskilled (males and females combined) have risen faster relative to urban wages in states where the terms of trade for agriculture have improved by more. Evidently, in states benefitting differentially from the agricultural commodity

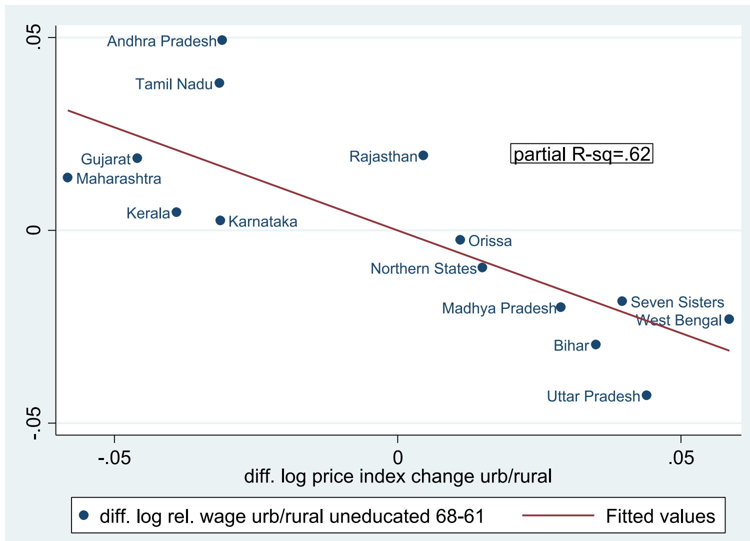

Fig. 17 Urban vs. rural wage changes and agricultural prices

boom, the secular decline in agriculture (and the associated decline in demand for unskilled labor) has been attenuated.

6 Conclusions

Real wages have risen across India in the past two decades, but the increase has been greater in rural areas and, especially, for unskilled workers. Broadly speaking, the changing wage structure *within* rural areas has been driven largely by relative supply factors, such as increased overall education levels and falling female LFP, whereas the changing wage structure *between* rural and urban areas has been driven largely by shifts in employment, notably into unskilled-intensive sectors like construction. Notwithstanding the rural construction boom, the recent expansion of the national public-works program (NREG) throughout rural India does not appear to be associated with shifts in the structure of wages (i.e., to the advantage of the unskilled) over the last decade. Finally, while structural transformation—the gradual movement of labor out of agriculture—has been the dominant trend of the last two decades in rural India, our evidence suggests that the recent upturn in agriculture's terms of trade may have muted the commensurate decline in demand for unskilled rural labor, contributing to growth in wages for the rural unskilled relative to their urban counterparts.

Endnotes

[1]See also Deaton and Drèze (2002) and Lanjouw and Murgai (2009) on the link between rural poverty in India and employment in casual agricultural wage labor.

[2]While SDI is a simple yet powerful framework for describing economic trends reflected in the labor market, it does not provide direct policy implications, such as which types of government interventions would be most effective in raising unskilled wages and thus in alleviating poverty. These questions are best studied in the context of specific program impact evaluations.

[3]Our measures of sectoral employment include the self-employed, an especially important category of workers in rural India given the large role of agriculture. Note, however, that the welfare impacts of unskilled wage growth are heterogeneous across this group. Smaller farmers may benefit from higher wages insofar as they are net suppliers of agricultural labor, whereas larger farmers are typically made worse off when labor costs rise (see Jacoby 2016).

[4]The definition of rural and urban areas follows that of the 1991 population census. Criteria for a community to be classified as urban are (i) a population of at least 5000, (ii) at least 75% of the male working population are non-agriculturists, and (iii) a density of at least 400 persons per square kilometer.

[5]Subsidiary status is much more temporary in nature, and as NSSO suggests, only about 1.3% in the rural and 0.1% in the urban areas had participated in two subsidiary economic activities during the period of 1 year before the date of survey in round 55 (NSSO, 2008).

[6]See Appendix in Table 4 for details on how industry codes were harmonized across NSS rounds.

[7]Service is a heterogeneous sector, especially in urban areas. In rural areas, the main service subsectors are easier to characterize. Between 1993–1994 and 2011–2012, the employment share of the wholesale/retail sub-sector grew from 4.9 to 11.5% and that of transport, post, and telecommunication grew from 1.8 to 5.0%, while that of personal and repair services declined between 1993 and 2004–2005 before rising to 2.7% by 2011–2012.

[8]Katz and Murphy (1992) estimate a σ of 1.41 between college and high school labor in the USA under stringent theoretical assumptions (see fn. 9). For the analysis of the *relative* importance of supply and demand factors, however, knowledge of σ is unnecessary.

[9]With more than two types of imperfectly substitutable labor, the change in relative wages between any two groups will also depend on how each of their net demands shift relative to that of the other groups. For simplicity, our analysis ignores such cross-price effects, i.e., we implicitly assume that the matrix of elasticities of complementarity is diagonal.

[10]Another measure of demand shifts involves a weighted average of *within* industry changes in group employment shares, but we do not focus on it here for reasons discussed in the Appendix.

[11]Why this premium arises is beyond the scope of the present investigation, but it may have something to do with the fact that a higher proportion of agricultural than nonagricultural workers in India are hired on a casual daily basis.

[12]State groups consist of Chhattisgarh with Madhya Pradesh (called Madhya Pradesh); Uttaranchal with UP (called Uttar Pradesh); Jharkhand with Bihar (called Bihar); Seven Sisters in the Northeast with Sikkim (called seven sisters); Goa, D & N Havelli, and D& Diu with Maharashtra; A&N Island with West Bengal (called West Bengal); Lakshadweep with Kerala (called Kerala); and Pondicherry with Tamil Nadu (called Tamil Nadu). Finally, Haryana, Punjab, Himachal Pradesh, Delhi, and Chandigarh are combined into Northern states.

[13]The same set of regressions with state fixed effects included yields very similar results (see Appendix Table 7).

[14]We have done a similar analysis using "raw," as opposed to be predicted (by SDI), wage changes with the same result.

[15]Equation (10) follows directly from the theoretical model of Jacoby (2016) under the simplifying assumption of no nontradable sector and no intermediate inputs.

Appendix

6.1 Within industry demand shift index

The within industry demand shift index takes the form

$$\Delta D^{w}_{ist} = \sum\nolimits_{k} \frac{N_{kst}}{N_{st}} \Delta \log\left(\frac{N_{ikst}}{N_{kst}}\right) \tag{11}$$

In this case, the first term is the initial share of industry k in total sectoral employment, whereas the second term is the relative growth of group i's employment in that industry. Thus, ΔD^{w}_{ist} captures industry-specific skill upgrading, an important driver of the changing wage structure in the USA and other developing countries over recent decades (Katz and Autor 1999).

If the second term in Eq. (11) is *the same across industries* (industry-neutral group employment growth), then $\Delta D^{W}_{ist} = \Delta S_{ist}$, in which case the within-industry demand shift for a particular demographic group is indistinguishable from that group's supply shift. In the case of India, ΔD^{W}_{ist} and ΔS_{ist} are close to being equal and this tight correlation carries over to the state-level indices, as shown in Fig. 18. For this reason, we ignore within industry demand shifts in our analysis.

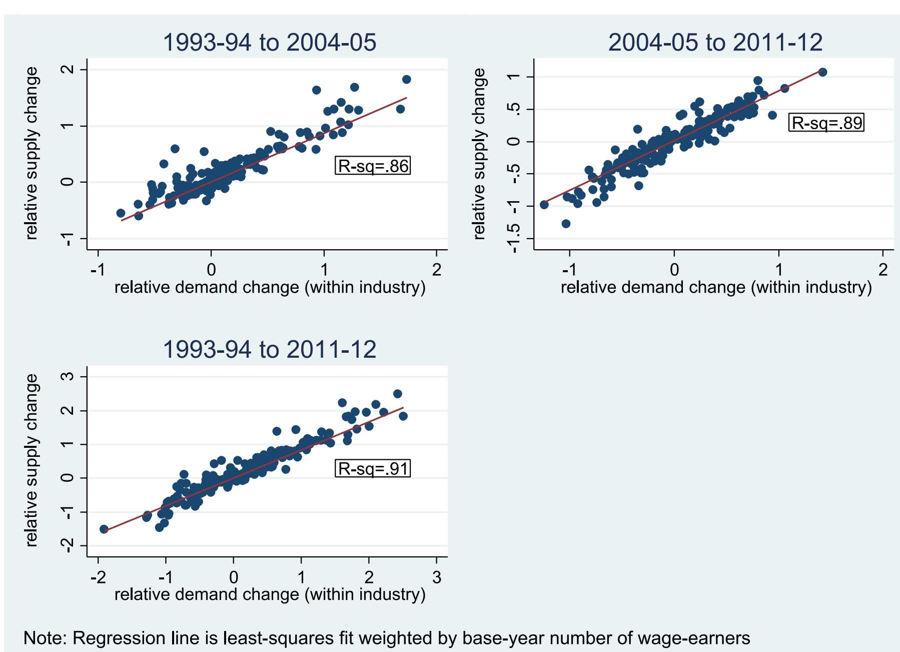

Fig. 18 Bivariate relationship between state/group supply and within-industry demand shifts

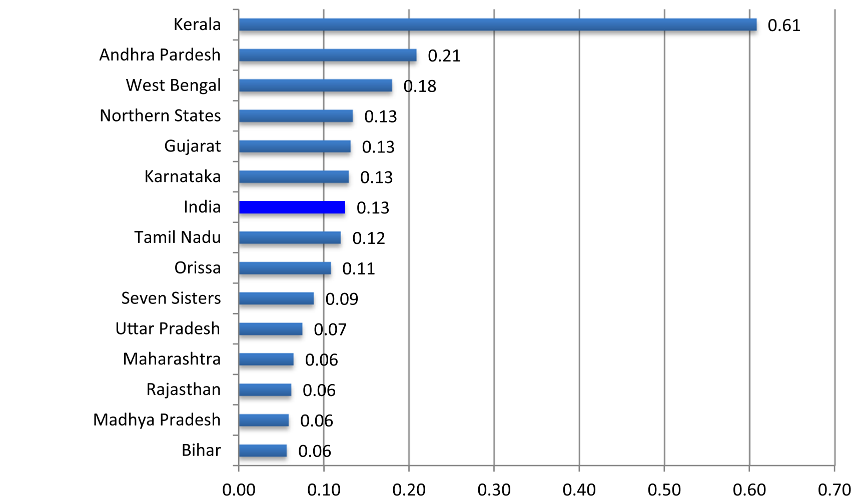

Fig. 19 Inter-censal change in urban population share (2001–2011)

6.2 Additional tables

Table 4 Harmonization of industry classification across rounds

Broader groups		Two digit codes			
		NIC-1987	NIC-1998	NIC-2004	NIC-2008
1. Agriculture	Agriculture, hunting and forestry, fishing	00–06	01–05	01–05	01–03
	Mining and quarrying	10–19	10–14	10–14	05–09
	Manufacturing	20–39	15–37	15–37	10–33
2. Mining-manufacturing-utilities	Utilities-electricity, gas and water supply	40–43	40–41	40–41	35–36
3. Construction	Construction	50–51	45	45	41–43
	Wholesale, retail trade and restaurant	60–69	50–55; 1712; 2892; 8532	50–55	45–47; 55–56
4. Services	Personal and repair services	96; 97	95	95; 96	94–98
	Transport, storage and communications	70–75	60–64; 9309	60–64	49–53; 58–63
5. Professional	Finance, insurance, real estate and business services	80–89	65–67; 5240; 70–74	65–67; 70–74	64–68; 77–82
	Public admin., sanitary services	90; 91	75	75	37–39; 69–75
	Health and medical and social services	93; 94	85; 90–93	85; 90–93	86–88; 90–93
	Education and research	92	80	80	85
	International services	98	99	99	99

Table 5 Adjustment of consumer price index for small states

State/UT	NSS code (61st, 64th, 66th)	State/UT to map CPI-AL from	NSS code (61st, 64th, 66th)
CPI-AL			
Chandigarh	4	Haryana	6
Delhi	7	Haryana	6
Uttarakhand	5	Uttar Pradesh	9
Jharkhand	20	Bihar	10
Sikkim	11	Assam	18
Arunachal Pradesh	12	Assam	18
Nagaland	13	Assam	18
Mizoram	15	Assam	18
A & N Islands	35	West Bengal	19
Chhattisgarh	22	MP	23
Daman & Diu	25	Gujarat	24
D & N Haveli	26	Gujarat	24
Goa	30	Maharashtra	27
Lakshadweep	31	Kerala	32
Pondicherry	34	Tamil Nadu	33
CPI-IW			
Uttarakhand	5	Uttar Pradesh	9
Sikkim	11	Assam	18
Arunachal Pradesh	12	Assam	18
Nagaland	13	Assam	18
Manipur	14	Assam	18
Mizoram	15	Assam	18
Meghalaya	17	Assam	18
A & N Islands	35	West Bengal	19
Daman & Diu	25	Gujarat	24
D & N Haveli	26	Gujarat	24
Lakshadweep	31	Kerala	32

Table 6 Estimated industry premia and casual labor shares

	Industry premium			Industry share in total casual labor		
Industry	1993–1994	2004–2005	2011–2012	1993–1994	2004–2005	2011–2012
Agriculture, forestry, fishing	− 0.22	− 0.38	− 0.27	74.28	67.82	54.69
Construction	0.02	0.11	0.05	7.7	16.43	29.82
Mining, manufacturing, utilities	0.04	0.02	0.06	8.89	8.87	8.73
Professional	0.26	0.23	0.15	2.37	1.01	0.69
Services	− 0.10	− 0.03	0.00	6.76	5.87	6.08
Total	0	0	0	100	100	100

Note: Industry premia sum to zero by construction. Industry share of casual labor is the % share (weighted) of each industry in total casual labor force

Table 7 Regression analysis with state fixed effects

Variables	2011/2012–2004/2005 only			
	(1)	(2)	(3)	(4)
	OLS	OLS	IV	IV
ΔSupply	− 0.207***	− 0.230***	− 0.297***	
	(0.027)	(0.036)	(0.057)	
ΔDemand	0.145**	0.204*	0.318***	
	(0.050)	(0.101)	(0.096)	
Δ(Demand − Supply)				0.307***
				(0.050)
Industry effect	− 0.042	0.075*	0.190	0.190
	(0.046)	(0.036)	(0.117)	(0.117)
ΔSupply = −ΔDemand (*p* value)	0.30	0.81	0.86	
Year FE	Y	N	N	N
State FE	Y	Y	Y	Y
Observations	448	224	224	224
R-squared	0.327	0.488	0.435	0.433

Notes: Robust standard errors in parentheses clustered on state (***$p < 0.01$, **$p < 0.05$, *$p < 0.1$). Dependent variable in all regression is mean log wage change of demographic group in state

Abbreviations
CES: Constant elasticity of substitution; CPI-AL: Consumer Price Index for Agricultural Labor; CPI-IW: Consumer Price Index for Industrial Workers; LFP: Labor force participation; NREGA: National Rural Employment Guarantee Act; NSS: National Sample Survey; SDI: Supply-Demand-Institutions

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