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Minimum wage compliance and household welfare: An analysis of over 1500 minimum wages in India

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ABSTRACT

In many developing countries there is a substantial difference between *de jure* and *de facto* regulation of minimum wages. We examine the consequences of this by looking at the heterogenous effects of minimum wages across compliance regimes in India. We show that minimum wages have a positive effect on wages, without a corresponding effect on employment. As a result, household consumption increases following increases in the minimum wage. However, the beneficial pass-through to wages and consumption is significantly reduced in low compliance regimes. Labour market reforms can improve workers' living standards but only if accompanied by effective compliance.

1. Introduction

Minimum wages aim to protect workers against low pay, while reducing poverty and inequality. Dube (2019) and Neumark et al. (2014) provide recent summaries of the impact of minimum wages on wages, employment, and poverty. Dube (2019) states that the evidence "points to a very muted effect of minimum wages on employment, while significantly increasing the earnings of low paid workers." Neumark et al. (2014), on the other hand, state that "we continue to view the available empirical evidence as indicating that minimum wages pose a tradeoff of higher wages for some, against job losses for others, and that policymakers need to bear this tradeoff in mind when making decisions about increasing the minimum wage." The contrasting conclusions reached by these authors indicate that we are still a long way off reaching a consensus on the effects of minimum wages.

These reviews focus on developed countries, where the assumption that employers are fully compliant with the minimum wage may be reasonable. However, this assumption can be misleading when applied to developing countries, where there is a substantial difference between de jure and de facto regulation. Rani et al. (2013) report noncompliance rates as high as 50% for some developing and emerging countries, with most of the countries in the study having noncompliance rates above 20%. Such a high rate of noncompliance complicates the analysis of minimum wages in developing countries (Neumark and Wascher, 2007).

We contribute to this literature in a number of distinct ways. By merging existing data sources we create a new data set for India with more than 1,500 minimum wage regimes by industrial sector. We use these data to estimate and examine minimum wage compliance rates in India from 1999 to 2011. Finally we exploit variation in minimum wages and compliance rates across states, and over time, to examine the impact of minimum wages and noncompliance on wages, consumption and work.

India provides an interesting study because the system of minimum wage determination in India generates over 1500 minimum wages across states and occupations. We show that noncompliance is a key feature of the Indian labour market during this period, with noncompliance rates as high as 90% for some workers. Noncompliance is higher for casual workers, for females, for unskilled workers and those working in rural areas.

Previous work in this area has tended to document the extent of noncompliance or its causes, without examining its impact on employment or welfare (Strobl and Walsh (2003), Ronconi (2010), Bhorat et al. (2012), Bernhardt et al. (2013), Rani et al. (2013), Kanbur et al. (2013), Garnero et al. (2015), Ham (2015), Garnero (2018) and Clemens and Strain (2020)). In the second part of the paper we extend this work by exploiting variation in compliance rates across states, and over time, to examine the impact of

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minimum wage noncompliance on labour market outcomes and household consumption. Our results show that increasing the minimum wage has a positive effect on wages in India. We find little evidence of significant employment effects in response to these higher wages. As a result, the higher wages that follow a minimum wage increase, lead to higher household consumption, with a marginal propensity to consume equal to 0.49. However, compliance matters. The beneficial pass-through of higher minimum wages to reported wages and consumption is substantially reduced in low compliance regimes.

These results extend the recent empirical analysis of minimum wage effects in India. Menon and Rodgers (2017) examine minimum wage effects in India assuming full compliance and find that minimum wages have little impact on labour market outcomes in urban areas but increase wages in the rural sector. Gudibande and Jacob (2020) examine the impact of minimum wages on domestic workers in India, and find positive effects on wages but no effect on employment. However, neither of these studies take account of noncompliance when estimating the minimum wage effect. Soundararajan (2019) allows for imperfect enforcement in her analysis of minimum wages for construction workers in India. She finds that in weak enforcement regimes wage effects are negligible and employment effects negative or zero, while in stronger enforcement regimes, wage effects are positive and employment effects positive or zero. However, she only considers construction workers and acknowledges that her measure of enforcement may not capture aspects such as corruption and collusive agreements that might directly impact on compliance. In contrast, we allow for heterogeneous minimum-wage effects, using a direct measure of noncompliance constructed from the data and examine wage and employment effects across all sectors of the economy.

Our findings have implications for the minimum wage literature in developing countries more generally. The evidence base for developing countries is small but growing.[1] However, as is the case for developed countries, there is little by way of consensus. Dinkelman and Ranchhod (2012) find that the expansion of minimum wages to domestic workers in South Africa increased wages significantly, with no noticeable effect on employment. Bosch and Manacorda (2010) find that the decline in the minimum wage in Mexico explains all of the growth in wage inequality in the bottom end of the wage distribution between the late 1980 s and early 2000 s, while Lemos (2007) and Sotomayor (2021) analyse minimum wages in Brazil and find that the legislation reduced inequality and poverty. In contrast, Neumark et al. (2006) find no evidence that minimum wages in Brazil lifted family incomes at the bottom of the distribution. Yamada (2016) finds that increasing the minimum wage in Indonesia resulted in an increase in wages, but a reduction in hours of work and formal employment. At the household level, he finds that raising the minimum wage resulted in an increase in earnings in the lower tail of the distribution. However, workers viewed the wage increase as transitory and thus increased savings rather than consumption following the minimum wage increase. He concludes that the welfare gain resulting from raising the minimum wage is small and attributable mostly to an increase in the leisure of low-wage workers. Gindling and Terrell (2007) find evidence of modest employment reductions following minimum wage increases in Costa Rica, while Gindling and Terrell (2009) find relatively large reductions in employment in Honduras.

Interpreting these cross-country differences is complicated by the variation in enforcement and compliance across countries in developing countries (Neumark and Munguía Corella (2021)). Munguia Correla (2019) uses data on a panel of developing countries to examine the impact of enforcement on minimum wages. He finds that the effect of the minimum wage varies with the level of enforcement. However, like Soundararajan (2019), he acknowledges that his measure of enforcement does not capture aspects such as corruption and collusive agreements that might directly impact on compliance and which may vary across countries. By highlighting the differences in the impact of minimum-wage laws across compliance regimes, our results add to this literature and helps potentially reconcile the wide variation in results reported across minimum studies in developing countries.

The remainder of the paper is organized as follows. Section 2 discusses the Indian economy and describes the structure of minimum wages in India. Section 3 describes our data. Section 4 presents our estimates of noncompliance and examines the determinants of noncompliance. Section 5 uses variation in minimum wages and noncompliance rates across states to identify their effect on wages, consumption and work. Section 6 presents a number of robustness checks and Section 7 concludes.

2. Institutional detail and the Indian economy

During the first decade of the 21st century the growth rate of GDP in India exceeded 7 per cent per annum. However, the process of economic growth has been uneven, with weak growth in the manufacturing sector and low productivity in the agricultural sector. Unlike other Asian economies, India's structural transformation has been atypical, with the services sector, as opposed to the export-oriented manufacturing sector, being the driver of growth (Binswanger-Mkhize (2013)). However, this growth has not been accompanied by corresponding growth in employment (Thomas (2012); Kannan and Raveendran (2009)). For instance, while GDP grew at 6.3 per cent from 1993 to 2004, employment growth was only 1.8 per cent (Papola (2013)).

The goal of the Minimum Wage Act 1948 (henceforth MW Act) is to prevent the exploitation of workers from payment of unduly low wages. The structuring of the minimum wage in India is somewhat different than typically found in many other countries, in that it explicitly targets informal casual labour. Thus the usual distinction between a regulated formal covered sector and an unregulated informal uncovered sector is not applicable to India. The Act does not define any criteria for fixing the level of the minimum wage. However, the recommendations in the sessions of the Indian Labor Conference, and guidelines given by the Supreme Court, offer guidance in fixing and revising the minimum wage. The Act allows the government to fix minimum wages for listed schedules of employments. This means that different wages are set for different occupations and also for different tasks within those occupations.[2] The Act also empowers the state governments to add occupations to the list of employment schedules, with the condition that there are 1000 or more workers engaged in a particular occupation or activity in the state. This gives rise to a complex system of minimum wage. As of 2013, there were 45 different schedules of employments specified by central government and 1699 schedules in the States and Union Territories.

The coverage of minimum wages in India is not universal. A little more than half of the workforce is self-employed in India and these workers are not covered under the Act. Instead the Act applies to wage earners, both casual and regular workers, in activities incorporated in the schedules of the Act. According to one estimate, around two thirds of wage earners in India are covered by the MW Act in 2009–10, with coverage varying between 93.4% (agricultural workers) and 30.5% (construction workers)

[1] For a detailed review of this literature see Belman and Wolfson (2014).

[2] Scheduled employments are quite detailed. A very small number of examples include stone breaking and stone crushing, toddy tapping, the manufacturing of matches and fireworks and the plucking of siali leaf, each of which potentially have a different minimum wage in different states.

(Rani et al. (2013)). Coverage is higher in rural areas than in urban areas.

The Act also mandates a periodic revision of the minimum wages at intervals not exceeding five years. To prevent wages from falling in real terms, a variable dearness allowance (VDA) is included with the basic rate of minimum wage. However there is some doubt as to the extent to which minimum wages have been revised with changes in the cost of living (Anant and Sundaram (1998)).

The Act is enforced centrally by the officers of the Central Industrial Relations Machinery and at state level by state labor departments. Under the Act, every employer is required to maintain records giving particulars of employees, wages paid to them, work performed by them and any other necessary information. During inspections it is not just the minimum wages law that is examined for compliance, but rather the entire suite of labour laws. An employer who pays any employee less than the minimum wage or contravenes any other provisions of the Act may be imprisoned for up to 6 months and/or subject to a fine of up to 500 rupees. Both the terms of imprisonment and the level of fines are fixed and neither depend on the number or severity of violations. However, since enforcement of the legislation tends to be very weak (Sundar (2010), (2015), Papola and Kannan (2017), Munguia Correla (2019)), the severity of the official punishment matters little when the certainty of punishment is so low.

3. Data

In this study we merge repeated cross-section data from National Sample Survey Office (NSSO) with administrative data from the Report on the Working of the Minimum Wages Act, 1948, to create a unique minimum wage database across states, industries and years. We use four rounds of the Employment-Unemployment survey conducted in the years 1999–2000, 2004–05, 2007–08 and 2011–12. These employment surveys have detailed information on earnings, consumption and employment, as well as socio-demographic characteristics of the household such as education, age, region of residence and social-religious status.

Indian society is divided along caste and religious lines. Hindus are the religious majority, while Muslims are the largest religious minority, followed by Christians and Sikhs. Of the hierarchically ordered caste system, Scheduled Tribes (STs), and Scheduled Castes (SCs) are at the lowest level and are the most economically marginalised, compared to Other Backward Classes and Hindu upper castes. Given a vast literature on the interplay of these social identities and labour market outcomes in India (Thorat and Neuman (2012)), we control for socio-religious status in our analysis.

Data are collected on industry, occupation, number of days worked and earnings under each employment activity for each worker using a 7-day reference period. Measuring the daily wage accurately is important because minimum wages in India are prescribed on a per-day basis. To construct the daily wage, we divide a worker's total wage and salary earnings for the week by a measure of daily work intensity during the week. Work intensity is measured for each day of the reference week and summed to get weekly work intensity. Since a person may be engaged in more than one type of activity on a single day, two potential activities are allowed for and measured each day. Each day of the reference week is looked upon as comprising either two 'half days' or a 'full day' for assigning the activity status. A person is considered 'working' (employed) for the entire day if he/ she had worked for 4 h or more during the day. If the person had worked for 1 h or more but < 4 h on a day, they are considered 'working' (employed) for half-day. The total wage or salary receivable for the week includes payment in cash, as well as the value of salary or wages in kind.

Workers are classified according to usual weekly work status. The self-employed operate their own farm or non-farm enterprises or are engaged independently in a profession or trade. The essential feature of the self-employed is that they have the autonomy and economic independence to carry out their operation. Although self-employed workers account for over 50% of the Indian workforce, they are not covered by minimum wage legislation. As a result, we omit them from our analysis.

Wage earners in India are classified as either regular or casual workers and workers are identified as such in the surveys. Regular wage/salaried employees are workers working in another person's enterprise and getting, in return, a salary or wage on a regular basis (and not on the basis of daily or periodic renewal of work contract). Casual labour refers to people casually engaged in another's enterprise and getting, in return, a wage according to the terms of the daily or periodic work contract. Since casual workers do not have a written fixed contract, they lack many of the employment rights of regular workers, and are entitled to fewer social security benefits such as pensions, health care and maternity benefits. Crucially however, casual workers are covered by the Minimum Wage Act 1948 and are therefore included in our analysis. When considering the robustness of our results we carry out the analysis separately for regular and casual workers.

Given the objective of minimum wages in developing countries, a focus on poverty and consumption is clearly warranted (Neumark et al. (2021)). While there is growing literature on the impact of minimum wages on poverty in developing countries (Gindling (2018)), much of it relies on income based measures of poverty and in some instances not all sources of income are available. In the spirit of the permanent income hypothesis we believe that consumption is a more appropriate measure of welfare than current income. To measure consumption, we use average monthly household consumption. As noted in previous work (Belser and Rani (2011)), the employment effect of a minimum wage change is more likely to occur through an adjustment in days worked, rather than an increase in unemployment. Therefore, when examining the employment effects, we use the number of days worked in the past week by the worker.

We match the individual survey data with minimum wage data taken from the Report on the Working of the Minimum Wages Act 1948, published annually by the Labour Bureau of the Government of India. This report provides data on the minimum wage rates which have been fixed for different 'schedules of employment' in states, where a schedule refers to a classification of work based on occupation and skill. We assign every schedule of employment a relevant 3-digit industry code based on National Industrial Classification (NIC) which is used in the NSS employment surveys to record the worker's industry of employment. This involved manually examining the description of every schedule of employment in each year and assigning them an NIC code based on the NIC label. More details on this mapping and examples are provided in the Appendix. The Labour Bureau also reports data on the number of firm inspections carried out at the state level each year. We use these data on state inspections as a measure of enforcement.[3]

We merge each year's minimum wage database with the corresponding employment survey using state codes and industry codes. Since industrial classification codes changed between the four rounds of employment surveys, we have used NIC-98 classification throughout. By combining the survey data with the Labour Bureau data, we develop a unique database containing minimum wage information at the state-industry level and enforcement at the state level.

[3] We are grateful to Vidhya Soundararajan for kindly providing us with the inspection data.

Summary statistics for the key variables used in our study are given in Table 1.

The average minimum wage across states, increased from 51.46 rupees ($0.70) in 1999 to 153.21 rupees ($2.08) in 2011. However, this simple average, hides substantial variation within and between states and occupations. In our analysis the minimum wage ranges from a low of 10 rupees a day (approximately $0.14) for workers engaged in loading and unloading in Ports and Docks in the state of Tamilnadu in 1999, to a high of 356.1 rupees a day (approximately $4.84) for workers in forestry and timber operations in the state of Kerala in 2011. In addition, we see that the average minimum wage exceeds the average daily wage in our sample in both 2004 and 2007. This suggests that noncompliance is likely to be prevalent in India. The third row of Table 1 shows that, across all years in our sample, 64% of workers reported a daily wage less than the legislated minimum wage. In the next section we look at this issue of noncompliance in detail.

4. Compliance

To estimate noncompliance, we consider the compliance index developed by Bhorat et al. (2013). They apply the Foster–Greer–T horbecke poverty metric (Foster et al. (1984)) to the measurement of noncompliance. Specifically, they propose estimating noncompliance rates using

$$NC_\alpha = \frac{1}{N}\sum_{i=1}^{N} I(MW_i > w_i)\left(\frac{MW_i - w_i}{MW_i}\right)^\alpha$$

where MW_i is the minimum wage applicable for individual i, w_i is the observed daily wage, I(a) is an indicator variable taking the value 1 if condition a is true and zero otherwise and α is a measure of violation-aversion. When α is equal to 0 this measures gives the proportion of the workers earning subminimum wages and is comparable to the traditional headcount measure reported by Rani et al. (2013). Setting α equal to 1 leads to a measure of the average shortfall in wages among noncompliers and is similar in spirit to the wage-bill effect reported by Strobl and Walsh (2003). However, this latter estimate treats any additional percentage increase in depth the same, irrespective of its magnitude. For example, a society in which everyone earns 20% below the minimum wage will be viewed the same as one in which half of the workers earn 10% below the minimum wage and the other half earn 30% below. In contrast a value of α equal to 2 imposes violation-aversion, with wages further below the threshold receiving larger weights that those just below. In the above example, using α equal to 2 would result in the second society having higher noncompliance than the first.[4]

Using this index for different values of α, we estimate three different measures of noncompliance. NC_0 which is the traditional headcount measure, NC_1/NC_0which is the average shortfall among the noncompliant sample and NC_2/NC_0 which is the violation-aversion adjusted measure for the noncompliant sample.

The results for all covered workers are given in Table 2.

Looking at the first column we see that the noncompliance was above 65% from 1999 to 2007 and increased during the first half of the decade. Although compliance has improved by 2011, the noncompliance rate remains at over 53%, which is still high relative to the rates reported in other developing countries (Rani et al. (2013)). The second and third columns shows the average percentage shortfall in wages relative to the minimum wage for the sample of non-compliers and the aversion adjusted measure respectively. They show a similar trend to head count rate, rising from 1999 to 2004 before declining through 2011. These estimates, which quantify the depth of noncompliance, show that not only are workers being paid less than the minimum wage, but the extent of noncompliance is large. Even in 2011, the average shortfall amounted to 31% of the minimum wage, which is similar to estimated shortfalls in other developing countries (Rani et al. (2013)).

As noted earlier a lack of effective enforcement is likely a key reason underlying India's high level of noncompliance. The lax enforcement is a result of insufficiently staffed labor inspectorate, weak sanctions, widespread rent-seeking behavior of officials, and weak unionization at local levels or even at the state levels (Papola and Kannan (2017)). The rate of compliance is also shown to depend on the system of minimum wages prevailing in a country (Garnero et al. (2015)). The complex system of minimum wages in India makes it cumbersome to administer and increases the burden on firms wishing to comply with the legislation. Enforcement of the Act is also hampered by very low awareness of the legislation. According to a 2007–08 evaluation of the Minimum Wages Act, 1948, in the stone-breaking and stone-crushing industry in Karnataka, only 30 per cent of employers and < 9 percent of workers were aware of the Act (India (2009)).

Fig. 1 show the minimum wage (left hand panel) and the headcount measure of noncompliance rates (right hand panel) across states over time. The data show substantial heterogeneity in minimum wages and noncompliance rates across states and over time. For example, in 2011 noncompliance ranged from a low headcount rate of 8.2% in Himachal Pradesh, to a high of 90.79% in Chhattisgarh. In addition, the time profile of noncompliance varies substantially across states. For example, between 2005 and 2011 the noncompliance rate increased in Chhattisgarh, declined slightly in Delhi and declined substantially in Punjab.

Table 3 presents noncompliance rates across industry, focusing on the headcount measure, as well as the share of covered employment and the poverty rate in each industry. This allows us to determine if it is the most vulnerable population that find themselves in industries with high non-compliance.

In keeping with previous work, we find that headcount noncompliance is high in the agricultural sector but low in Electricity, Gas and Water supply, and Finance, Insurance and Retail. Furthermore the agricultural sector accounts for the vast majority of covered workers and has the highest poverty rate across all industrial sectors. Electricity, Gas and Water supply has the second lowest poverty rate, although it accounts for a very small proportion of covered employment. These raw data suggest that noncompliance is highest in large sectors catering for the most vulnerable workers in India. We will return to this issue in more detail when we consider the individual determinants of non-compliance.

To examine the determinants of noncompliance in more detail, we estimate the following two-way fixed effects model:

$$NC_{ist} = \beta_0 + \beta_1 MW_{st} + \beta_2 X_{ist} + \beta_3 Z_{st} + \beta_4 D_s + \beta_5 D_t + \varepsilon_{ist} \quad (1)$$

where MW_{st} is the minimum wage in state s at time t, X_{ist} is a vector of individual characteristics, including gender, education, religious/-social status, location, age and marital status and Z_{st} is a vector of time varying state characteristics, including state population and state gdp per capita. D_s and D_t are state and year dummies respectively. NC_{ist} is a binary variable taking the value of 1 if individual i in state s at time t, is paid below her minimum wage and zero otherwise. The results are given in Table 4.

Looking at the results we see that higher minimum wages are associated with higher noncompliance. This is consistent with both theoretical predictions (Ashenfelter and Smith (1979)) and recent empirical work (Ham (2018) and Clemens and Strain (2020)). Looking at the individual characteristics we see that the headcount

[4] By giving less weight to wages just below the threshold the NC_2 measure may also be affected less by measurement error in daily wages than a simple head count measure. We consider the issue of measurement error for the head count compliance measure in Section 6.

Table 1
Descriptive Statistics by year.

	1999	2004	2007	2011	Total
Nominal Minimum Wage	51.46	78.73	94.76	153.21	97.23
	(12.10)	(17.85)	(24.29)	(35.79)	(46.66)
Nominal Daily Wage	58.44	76.11	91.93	194.7	90.91
	(88.92)	(92.53)	(103.0)	(257.6)	(150.9)
Share of Workers paid below Minimum Wage	0.65(0.29)	0.74(0.27)	0.70(0.30)	0.53(0.30)	0.64(0.30)
Monthly per capita Nominal Consumption	461.8	620.9	700.1	1414.2	693.2
	(375.7)	(555.6)	(552.0)	(1277.5)	(782.1)
Weekly Work Intensity	5.867	5.788	5.875	6.308	5.947
	(1.512)	(1.559)	(1.560)	(1.326)	(1.498)
Age (in Years)	34.63	34.69	35.31	36.47	35.07
	(12.28)	(12.30)	(12.32)	(12.44)	(12.34)
Scheduled Tribes (ST)	0.129	0.0881	0.148	0.101	0.120
	(0.335)	(0.283)	(0.355)	(0.301)	(0.325)
Scheduled Castes (SC)	0.311	0.320	0.316	0.280	0.307
	(0.463)	(0.467)	(0.465)	(0.449)	(0.461)
Other Backward Castes (OBC)	0.315	0.382	0.309	0.355	0.330
	(0.464)	(0.486)	(0.462)	(0.479)	(0.470)
Muslim	0.0761	0.0701	0.0924	0.108	0.0833
	(0.265)	(0.255)	(0.290)	(0.311)	(0.276)
Hindu Forward	0.157	0.127	0.121	0.145	0.148
	(0.363)	(0.333)	(0.326)	(0.352)	(0.355)
Christian	0.00774	0.00694	0.00749	0.00697	0.00747
	(0.0877)	(0.0830)	(0.0862)	(0.0832)	(0.0861)
Other Religion	0.00452	0.00568	0.00612	0.00397	0.00469
	(0.0671)	(0.0751)	(0.0780)	(0.0629)	(0.0683)
Casual Worker	0.811	0.777	0.828	0.736	0.794
	(0.392)	(0.416)	(0.378)	(0.441)	(0.405)
Never Married	0.177	0.199	0.178	0.185	0.181
	(0.382)	(0.400)	(0.382)	(0.388)	(0.385)
Currently Married	0.760	0.732	0.763	0.751	0.755
	(0.427)	(0.443)	(0.425)	(0.432)	(0.430)
Widowed	0.0536	0.0596	0.0516	0.0574	0.0549
	(0.225)	(0.237)	(0.221)	(0.233)	(0.228)
Divorced/Separated	0.00969	0.00862	0.00775	0.00673	0.00879
	(0.0980)	(0.0924)	(0.0877)	(0.0817)	(0.0934)
Male	0.691	0.715	0.736	0.759	0.711
	(0.462)	(0.451)	(0.441)	(0.428)	(0.453)
Unskilled	0.877	0.853	0.874	0.776	0.854
	(0.329)	(0.354)	(0.332)	(0.417)	(0.354)
Rural	0.816	0.780	0.841	0.728	0.797
	(0.387)	(0.414)	(0.366)	(0.445)	(0.403)
Agriculture & allied	0.668	0.558	0.583	0.413	0.596
	(0.471)	(0.497)	(0.493)	(0.492)	(0.491)
Mining & quarrying	0.00977	0.0120	0.0130	0.00956	0.0103
	(0.0984)	(0.109)	(0.113)	(0.0973)	(0.101)
Manufacturing	0.102	0.139	0.0898	0.135	0.112
	(0.303)	(0.346)	(0.286)	(0.341)	(0.315)
Electricity, Gas & Water Supply	0.00364	0.00471	0.00499	0.00506	0.00417
	(0.0602)	(0.0685)	(0.0705)	(0.0709)	(0.0644)
Construction	0.104	0.166	0.202	0.263	0.152
	(0.305)	(0.372)	(0.401)	(0.440)	(0.359)
Trade, Rest & Hotels	0.0229	0.0275	0.0267	0.0367	0.0266
	(0.150)	(0.164)	(0.161)	(0.188)	(0.161)
Transport Storage & Communication	0.0167	0.0156	0.0197	0.0242	0.0183
	(0.128)	(0.124)	(0.139)	(0.154)	(0.134)
Finance Insurance & Real Estate	0.00200	0.00456	0.00492	0.0136	0.00489
	(0.0446)	(0.0673)	(0.0700)	(0.116)	(0.0698)
Community Social & Personal Services	0.0707	0.0727	0.0559	0.100	0.0755
	(0.256)	(0.260)	(0.230)	(0.300)	(0.264)

Source: Authors' own calculations using NSSO data and administrative data from the Report on the Working of the Minimum Wages Act, 1948.
Notes: Standard Deviations in parentheses. All statistics are weighted.

measure of noncompliance is higher for women, casual workers, younger workers, those living in rural areas and unskilled workers. This is consistent with previous work that has found that unskilled and vulnerable workers are more likely to be the victims of noncompliance (Bernhardt et al. (2013)).

In the remainder of the paper we exploit variation across states and time to examine the impact of minimum wages and compliance on labour market outcomes and household consumption. Although the estimation of noncompliance is constructed using the minimum wage, we argue that our minimum wage and compliance measures are capturing distinct issues of the wage setting process. Typical measures of bindingness such as the level of the minimum wage, Kaitz index or the 'fraction affected', defined as the share of workers between the new and old minimum wages are valid only with full compliance. Card (1992) is explicit about this. He argues that the 'fraction affected' is an appropriate measure of bindingness in that 'a rise in the minimum wage is most likely to affect employees of complying firms.' However, it is possible to have a high minimum wage and at the same time high noncompliance, a situation described by Garnero et al. (2015) as a

Table 2
Non-Compliance rates for all workers aged 15 and above.

	NC_0	NC_1 /NC_0	NC_2 /NC_0
1999	65.39	34.95	15.86
2004	74.08	37.16	17.81
2007	70.05	32.55	13.87
2011	53.24	31.00	13.27

Source: Authors' own calculations using NSSO data and administrative data from the Report on the Working of the Minimum Wages Act, 1948.
Notes: Each column represents a different measure of compliance. NC_0 is the headcount measure of noncompliance, NC_1 /NC_0 is the average shortfall among the non-compliant sample and NC_2/NC_0 is the violation-aversion adjusted measure for the noncompliant sample. Weights were used in calculating all measures.

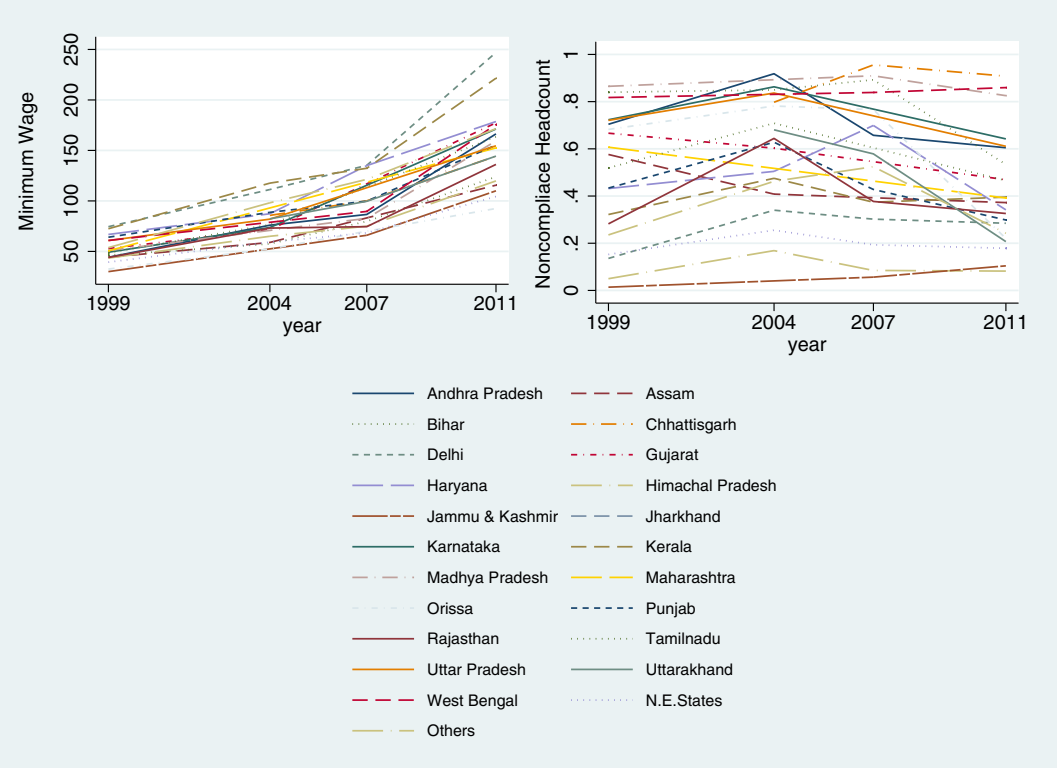

Fig. 1. Minimum Wage and Noncompliance across States and Time Source: Authors' own calculations using NSSO data and administrative data from the Report on the Working of the Minimum Wages Act, 1948.

system with sharp teeth (high minimum wage) but an empty mouth (high noncompliance). By interacting the level of the minimum wage with the degree of noncompliance we can empirically examine the trade-off between these distinct features of the minimum wage setting process.

5. Minimum wage effects and compliance

In this section we focus on the headcount measure of noncompliance and examine the impact of minimum wages on outcomes.[5] We use the variation in minimum wages and noncompliance rates across states to identify their effect on wages, consumption and work. We follow the large literature that uses regional variation in labour market reforms to identify the effect of labour market regulations on labour market outcomes (Card (1992), Neumark and Wascher (1992), Besley and Burgess (2004), Allegretto et al. (2017), Menon and Rodgers (2017). Allegreto et al. (2017) describe the canonical two-way fixed effects minimum wage model as follows:

$$Y_{ist} = \beta_0 + \beta_1 MW_{st} + \beta_2 X_{ist} + \beta_3 D_s + \beta_4 D_t + \varepsilon_{ist}$$

where Y_{ist} is a labour market outcome for individual i in state s at time t, D_s and D_t are state and time dummies respectively and X_{ist} is a vector of controls. As discussed in Allegretto et al. (2017), the identification of the minimum wage effects in this model relies on the parallel trends assumption, which assumes that the evolution of the outcome variable over time would be the same across states in the absence of a minimum wage change.[6]

In this paper we use a variation of the canonical model that incorporates noncompliance as follows:

[5] We find similar results when we use the other measures of compliance. These results are available in the online Appendix.

[6] We will examine the robustness of our results to the parallel trend assumption in Section 6.

Table 3
Industry Characteristics and Non-Compliance rates by Industry.

Agriculture & Allied	1999	2004	2007	2011
Share of Employment	66.65	56.86	61.64	42.19
Poverty Rate	40.82	55.91	NA	41.09
NC_0	76.28	84.68	80.66	58.30
Mining & Quarrying				
Share of Employment	0.89	1.20	1.18	0.97
Poverty Rate	27.92	49.93	NA	33.95
NC_0	46.23	74.95	63.22	70.24
Manufacturing				
Share of Employment	10.76	13.78	8.91	13.77
Poverty Rate	20.24	31.01	NA	19.80
NC_0	50.44	66.01	58.17	52.13
Electricity, Gas & Water Supply				
Share of Employment	0.38	0.49	0.52	0.53
Poverty Rate	6.30	9.86	NA	8.13
NC_0	2.68	4.56	10.38	9.76
Construction				
Share of Employment	9.45	15.32	16.52	24.42
Poverty Rate	33.80	50.01	NA	38.45
NC_0	54.77	73.98	64.31	56.39
Trade, Rest & Hotels				
Share of Employment	2.16	2.84	2.80	3.81
Poverty Rate	17.96	31.73	NA	20.61
NC_0	52.06	69.64	57.50	54.66
Transport Storage & Communication				
Share of Employment	1.88	1.57	1.99	2.55
Poverty Rate	15.40	22.82	NA	13.18
NC_0	8.84	20.49	28.15	23.98
Finance Insurance & Real Estate				
Share of Employment	0.24	0.48	0.53	1.40
Poverty Rate	11.37	14.18	NA	5.56
NC_0	23.02	46.66	49.34	39.56
Community Social & Personal Services				
Share of Employment	7.58	7.47	5.91	10.36
Poverty Rate	17.50	12.16	NA	13.97
NC_0	24.62	27.82	28.77	34.65

Source: Authors' own calculations using NSSO data and administrative data from the Report on the Working of the Minimum Wages Act, 1948. Data on the poverty threshold are obtained from the Lakadwala Committee report for 1999 and from the Tendulkar Committee report for 2004 and 2011.
Notes: Each panel refers to a different industry. NC_0 is the headcount measure of noncompliance. Weights were used in calculating all measures.

$$Y_{ist} = \beta_0 + \beta_1 MW_{st} + \beta_2 NC_{0st} + \beta_3 MW_{st} * NC_{0st} + \beta_4 X_{ist} + \beta_5 Z_{st} + \beta_6 D_s + \beta_7 D_t + \varepsilon_{ist} \quad (2)$$

The interaction term allows the effect of the minimum wage to differ across compliance regimes. We consider three outcomes, Y_{ist}; nominal wages, employment and nominal consumption. X_{ist} is a vector of individual characteristics including social status, whether the worker is regular or casual, gender, age, and education. Z_{st} is a vector of time varying state characteristics included to control for local labour demand conditions, specifically state population and GDP.[7]

In a competitive labour market a binding minimum wage raises the marginal cost of labour above the market wage, even for firms who do not comply with the legislation. If firms can only choose to either comply or not comply with the minimum wage for all its workers, this increase in marginal cost induces the noncomplying employer to reduce employment below the competitive level but to still employ more workers than would have been the case if they had complied with the law (Chang and Ehlrich (1985)). This implies that the direct minimum wage effect on employment, β_1, should be negative and the interaction with noncompliance, β_3, positive. If, on the other hand, employers can choose to partially comply with the minimum wage, that is pay some workers the minimum wage and others less, then Yaniv (2001) shows, that in a competitive labour market, employment in all firms will be reduced to the full compliance level, even in firms that are not fully complying. In this case the direct effect of the minimum wage will again be negative but the interaction effect zero. Basu et al. (2010) model employment and wage outcomes in an imperfect labour market as a result of an exogenously set level of enforcement and show that moderate increases in the minimum wages can increase employment and that this effect is stronger in labour markets with higher enforcement, implying that β_1,should be positive and the interaction with noncompliance, β_3, negative.

The two-way fixed effects approach is commonly used to identify the causal effects of minimum wages. As noted above, this approach relies on a parallel trend assumption to identify causal effects. Our estimation however has the added complication, that, in addition to the minimum wage, we must also deal with potential endogeneity of the compliance measure. Without further adjustment, identification in (2) requires extending the parallel trend assumption so that the evolution of the outcome variable over time is the same across states in the absence of either a minimum wage or compliance change. We return to this issue in Section 6, where we consider an alternative, instrumental variable approach, for dealing with the endogeneity of compliance.

[7] In keeping with previous work on compliance (Soundararajan (2019), Clemens and Strain (2020)) the results presented in the main text examine nominal wages. Focusing on nominal wages avoids confounding minimum wage increases with price changes when focusing on compliance and pass-through. However, the results using real wages lead to very similar conclusions and are provided in the Online Appendix. We have also estimated specifications using higher order terms for the minimum wage, as well as a specification including industry fixed effects and both yielded similar results to those reported in the paper.

Table 4
Determinants of Noncompliance.

	Probit Marginal Effects
Minimum Wage	0.005***
	(0.001)
lnPopState	0.011
	(0.009)
lnGDPState	−0.226**
	(0.079)
Age	−0.004***
	(0.0004)
Casual worker	0.107***
	(0.032)
SC	−0.047*
	(0.020)
OBC	−0.045*
	(0.020)
Muslim	−0.049*
	(0.021)
Hindu	−0.087***
	(0.021)
Christian	−0.045
	(0.038)
Other Religion	−0.123***
	(0.031)
Female	0.247***
	(0.029)
Married	−0.030***
	(0.009)
Widowed	−0.005
	(0.014)
Divorced	0.019
	(0.017)
Urban	−0.097***
	(0.023)
Skilled	−0.152***
	(0.015)
N	179,337

Source: Authors' own calculations using NSSO data and administrative data from the Report on the Working of the Minimum Wages Act, 1948.
Notes: The results are based on a two-way fixed effects probit regression. The dependent variable is a binary variable indicating noncompliance. State and year dummies are included in the regression. Clustered standard errors by state in parentheses. All regressions are weighted.
$^{+}$ $p < .1$, * $p < .05$, ** $p < .01$, *** $p < .001$.

The results obtained from estimating equation (2) are given in Table 5.[8]

We begin by looking at the results for wages. The estimated minimum wage effect given in the first column measures the pass-through of the minimum wage to daily wages averaged across all compliance regimes. We see that a one rupee increase in the daily minimum wage leads to a 32 paise increase in the daily wage (a paise is 1/100th of a rupee) but this effect is not statistically significantly different from zero. To put the magnitude of this effect in context, a recent paper on minimum wage non-compliance in the United States finds that each dollar of minimum wage increase predicts, on average, a wage gain of roughly 27 cents (Clemens and Strain (2020)). However, in both our base result and that reported by Clemens and Strain (2020), the impact of the minimum wage is averaged over all compliance regimes. This may explain the relatively low and statistically insignificant estimate.

To examine the role of compliance in determining the minimum wage pass-through we estimate equation (2). This specification includes the direct effect of both the minimum wage and compliance rate and also the interaction between the two. The results for the wage equation are given in column (2) of Table 5. The coefficient on the minimum wage variable remains positive and is now statistically significant, showing that minimum wages have a statistically significant positive effect on daily wages in full compliance regimes. The interaction effect is negative indicating that, as

Table 5
The effects of Minimum Wages and Compliance on Labour Market outcomes.

	(1) Nominal Daily Wage	(2) Nominal Daily Wage	(3) Weekly Work Intensity	(4) Weekly Work Intensity	(5) Nominal Monthly per capita Consumption	(6) Nominal Monthly per capita Consumption
Minimum Wage	0.323	1.438***	0.00146	0.000412	7.694**	14.60***
	(0.514)	(0.346)	(0.00294)	(0.00354)	(2.196)	(1.402)
NC_0	9.680	126.6***	−0.443	−0.553	−246.0	478.2**
	(40.58)	(31.56)	(0.329)	(0.364)	(219.7)	(156.8)
Minimum Wage # NC_0		−1.651***		0.00155		−10.23***
		(0.237)		(0.00246)		(1.054)
N	179,337	179,337	179,337	179,337	179,336	179,336

Source: Authors' own calculations using NSSO data and administrative data from the Report on the Working of the Minimum Wages Act, 1948.
Notes: Each column presents a seperate two-way fixed effects regression. The dependent variable in the models estimated in columns 1 and 2 is the individual nominal daily wage. The dependent variable in the models estimated in columns 3 and 4 is a measure of weekly work intensity and the dependent variable in the models estimated in columns 5 and 6 is monthly per-capita nominal household consumption. State and year dummies are included in all regressions. Additional covariates include a constant, the logarithm of state population, the logarithm of state GDP, age and its square (in years) and dummy variables for socio-religious status, regular work status, gender, marital status, urban residence and education level. Clustered standard errors by state in parentheses. All regressions are weighted.
$^{+}$ $p < .1$, * $p < .05$, ** $p < .01$, *** $p < .001$.

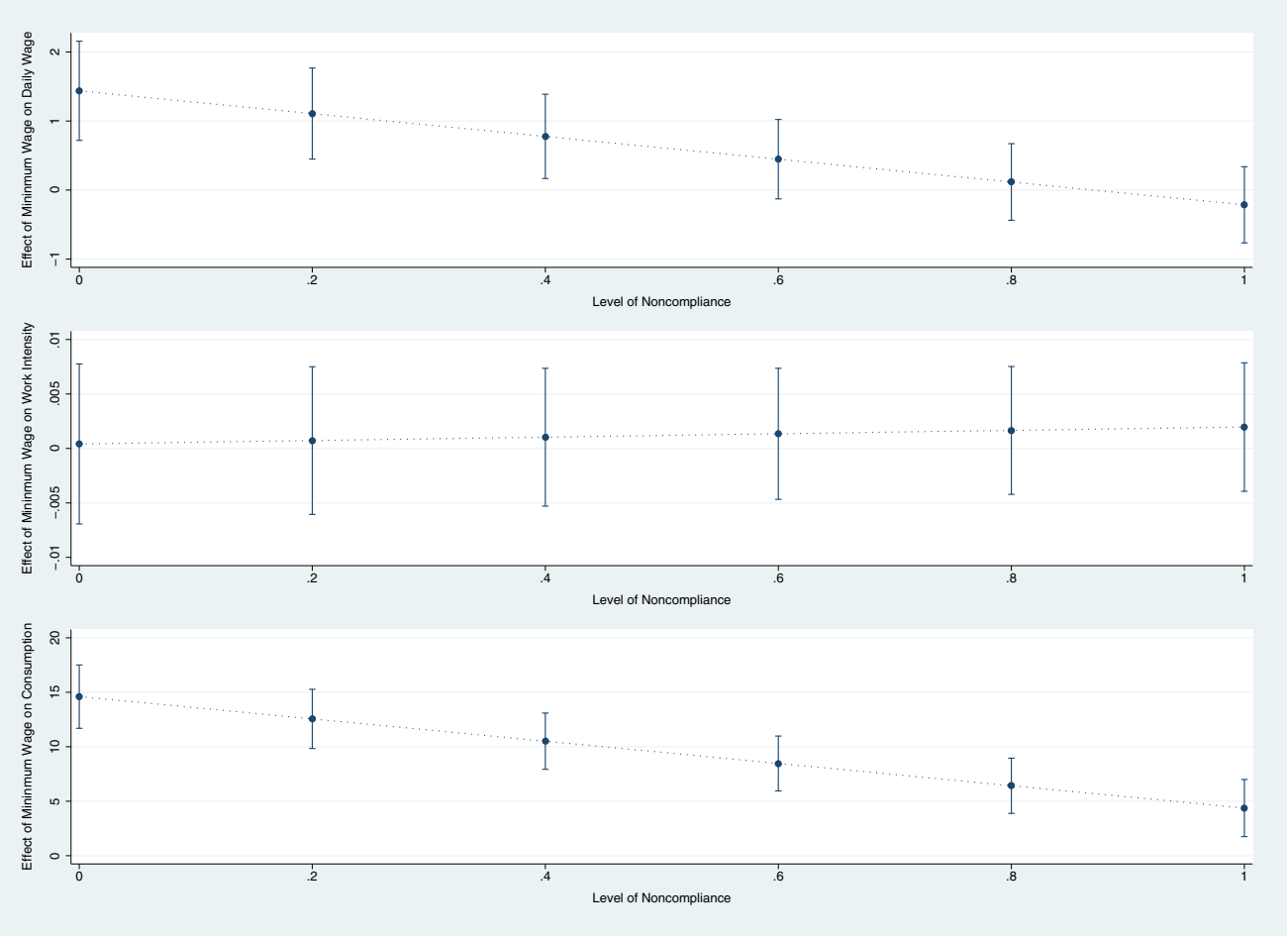

Fig. 2. The marginal effect of the minimum wage on Labour Outcomes evaluated at different level of compliance. Source: Authors' own calculations using NSSO data and administrative data from the Report on the Working of the Minimum Wages Act, 1948. Notes: Each panel refers to a different two-way fixed effects regression. The dependent variable in the model in the top panel is the individual nominal daily wage. The dependent variable in the model estimated in the middle panel is a measure of weekly work intensity and the dependent variable in the model estimated in the bottom panel is monthly per-capita nominal household consumption.. The dots in the graphs represent the marginal of effect of the minimum wage on outcomes evaluated at different levels of compliance. State and year dummies are included in all regressions. Additional covariates include a constant, the logarithm of state population, the logarithm of state GDP, age and its square (in years) and dummy variables for socio-religious status, regular work status, marital status, gender and education level, All regressions are weighted. The vertical lines represent 95% confidence intervals around the point estimate.

expected, higher rates of noncompliance reduce the pass-through of minimum wage increases to daily wages. This is illustrated in the top panel of Fig. 2 which plots the marginal effects of the minimum wage on daily wages for a range of compliance levels, along with 95% confidence intervals.

Our results imply that a worker in a labour market where noncompliance is at most 20% would expect to receive almost all of the minimum wage increase. In contrast, a worker in a labour market where the noncompliance rate is 60% receives 45 paise of each rupee increase in the minimum wage, while a worker in a labour market with a noncompliance rate of 80% receives only 12 paise of each rupee increase in the minimum wage. These results highlight the importance of distinguishing between *de jure* and *de facto* regulation (Neumark et al. (2021), Bhorat et al. (2019), Kanbur and Ronconi (2018)).

Columns (3) and (4) of Table 5 examine the impact of minimum wages on work intensity. As noted above, in a competitive labour market β_1 should be negative and β_3 non-negative when examining employment. We find no evidence of this. The middle panel of Fig. 2 plots the marginal effects of the minimum wage on employment across compliance regimes. Our results suggest that, if anything, minimum wages have a weak positive effect on work activity on India and that this effect does not vary much with compliance, but none of these effects are statistically different from zero. The estimated average employment elasticity assuming full compliance is 0.00002, indistinguishable from zero. This is in keeping with Soundararajan (2019) and Menon and Rodgers (2017) who also found that minimum wages tended to have a small positive or zero effect on employment in India.

Given the positive wage effects and the lack of employment effects we would expect the minimum wage increases to be reflected in higher household consumption. This is precisely what we observe in columns (5) and (6) of Table 5. As is the case with wages, we find that higher minimum wages are associated with higher levels of consumption. This contrasts to the findings of Yamada (2016), who finds that although minimum wage increases in Indonesia resulted in increased earnings in the lower tail of the distribution, there was no corresponding increase in consumption. This partly reflects negative employment responses in Indonesia but also an apparent belief among Indonesian workers that minimum wage increases were transitory and did not increase permanent income. This he argued, raised serious concerns regarding the effectiveness of minimum wage for improving living standards.

Our findings for India indicate that minimum wages raise wages without reducing employment. Furthermore, Indian workers viewed this increase as an increase in permanent income and

increased consumption accordingly. The marginal effects of minimum wages on consumption across compliance regimes are presented in the bottom panel of Fig. 2. Our results show that, in a full compliance regime, a one rupee increase in the daily minimum wage results in a 14.61 rupee increase in monthly household consumption, implying a marginal propensity to consume out of the minimum wage increase of 0.49. Thus, the minimum wage is effective in raising living standards in India. However, once again compliance matters. A worker in a labour market with noncompliance rates of 80% would see consumption rise by only 6.41 rupees.

Combined, the results in Table 5 and Fig. 2 show that minimum wages have a positive effect on wages and consumption in India without significant effects on employment. However, compliance matters for wages and consumption. The beneficial pass-through of higher minimum wages to wages and consumption is reduced substantially in low compliance regimes.

Our findings suggest that labour market reforms can improve workers' living standards but only if accompanied by effective compliance. Higher minimum wages are unlikely to improve welfare if firms can simply respond by avoiding the regulation. When thinking about measures to increase compliance one can either focus on increasing the severity of the punishment associated with violations or focus on increasing the enforcement of the existing legislation. While increasing the severity of the punishment is likely to require fewer resources it is unlikely to be effective in India. As noted earlier enforcement of existing legislation is very weak and increasing severity, when the probability of prosecution is very low, is likely to be of limited use.

The alternative approach requires stricter enforcement of existing legislation, combined with a greater awareness of workers' rights. Gindling et al. (2015) analyse one such reform, introduced in Costa Rica in 2010, with the explicit purpose of improving compliance with the minimum wage legislation. The Campana Nacinal de Salarios used three instruments to improve compliance; a publicity campaign was launched to create a level of consciousness among employers and workers regarding the minimum wage; workers were encouraged to report employers who paid less than the minimum wage; and there was an increase in labor inspections targeting minimum wage violations. Gindling et al. (2015) found that the Campaign lead to an increase in compliance with minimum wage laws, with the largest increase in wages for women, younger workers and the less educated workers. Consistent with our findings, they find no evidence that the Campaign had a negative impact on the employment of full-time workers whose wages were increased, although there is weak evidence that there was a reduction in part-time employment. Such a reform offers a template for changing labour market regulation in India.

Some reforms are currently under way. In 2015 the Government of Kerala introduced the Wage Protection System (WPS). The system substantially increased the cost of non-compliance. The fine to an employer for non-payment was increased 200-fold, from 500 Rupees to 100,000 rupees and the fine for non-compliance of other provisions of the Act was increased from 500 Rupees to 1000 Rupees. However, as noted earlier, any such increase in punishment can only be effective if accompanied by enhanced enforcement. Under the WPS, salaries and allowance of workers governed by the minimum wage legislation are paid directly to their bank accounts. The Labour Department then monitors the system, which in theory can help with track enforcement of the legislation. The WPS also greatly reduces the administrative burden on firms complying with labour market regulations, reducing the number of forms that must be maintained from twenty one to just one. By reducing the cost of compliance and enforcement, while at the same time increasing the cost of noncompliance, this reform has the potential to increase firm compliance with the minimum wage, which given our findings will improve workers' living standards.

6. Robustness checks

a. Regressions by Subgroups

To examine the robustness of our results across subgroups we re-estimate equation (2) across a range of worker classifications. We distinguish between casual and regular workers, male and female workers, rural and urban workers, young (aged 25 or less) and older workers, as well as looking at socio-religious groupings. The results for these specifications are given in Fig. 3.

While there are some differences in the magnitudes across groups, the key results from the earlier analysis are evident across all subgroups; minimum wages have a positive effect on wages and consumption, an effect which is mitigated by higher noncompliance. However, minimum wages have only a weak effect on employment.

b. Sensitivity of results to alternative thresholds.

To the extent that the wage data may be prone to measurement error, it is useful to assess the sensitivity of our results to alternative definitions of the minimum wage threshold. We follow previous research in this area by defining an alternative measure of noncompliance based on 85% of the minimum wage level (Rani et al. (2013), Garnero et al. (2015)). As expected the incidence of noncompliance is lower when the 85% threshold is used, but still remains very high. For example the noncompliance headcount rate falls from 65% to 53% in 1999 when the 85% threshold is used. However, the correlation over states and time with both measures is 0.96. Of particular interest to us is the robustness of our regression results to alternative thresholds. The results of the regression analysis using 85% threshold are given in Fig. 4 and are very similar to those reported earlier. While allowing for measurement error may affect the estimated level of compliance somewhat, it does not change the estimated relationships between compliance, the minimum wage and labour market outcomes.

c. State level aggregation with State-Specific time trends

The identification of the minimum wage effects in equation (2) relies on the parallel trends assumption, which assumes that the evolution of the outcome variable over time would be the same across states in the absence of a minimum wage change. This assumption has been challenged in the US literature that relies on state variation and there has been disagreement over how to proceed. Meer and West (2016) argue for the estimation of a trend break model. However, Addison et al. (2015) question the implications of their specification. Allegretto et al. (2017) argue that linear state-specific time trends may help overcome identification problems arising from a failure of the parallel trend assumption.[9] Following Allegretto et al. (2017) we modify equation (2) by including state-specific time trends as follows:

$$Y_{ist} = \beta_0 + \beta_1 MW_{st} + \beta_2 NC_{0st} + \beta_3 MW_{st} * NC_{0st} + \beta_4 X_{ist} + \beta_5 Z_{st} + \beta_6 D_s + \beta_7 D_t + \beta_8 D_s * t + \varepsilon_{ist} \quad (3)$$

The results of estimating equation (3) are given in Table 6 and are consistent with those reported in Section 5. The models including state-specific time trends still show a positive direct effect of the minimum wage on wages and consumption, though the effect is less precisely estimated than before. Once again, the impact of the minimum wage on wages and consumption declines as non-

[9] Neumark et al. (2014) call for higher order trends but Allegretto et al. (2017) find that the inclusion of such higher order trends makes little difference in their models.

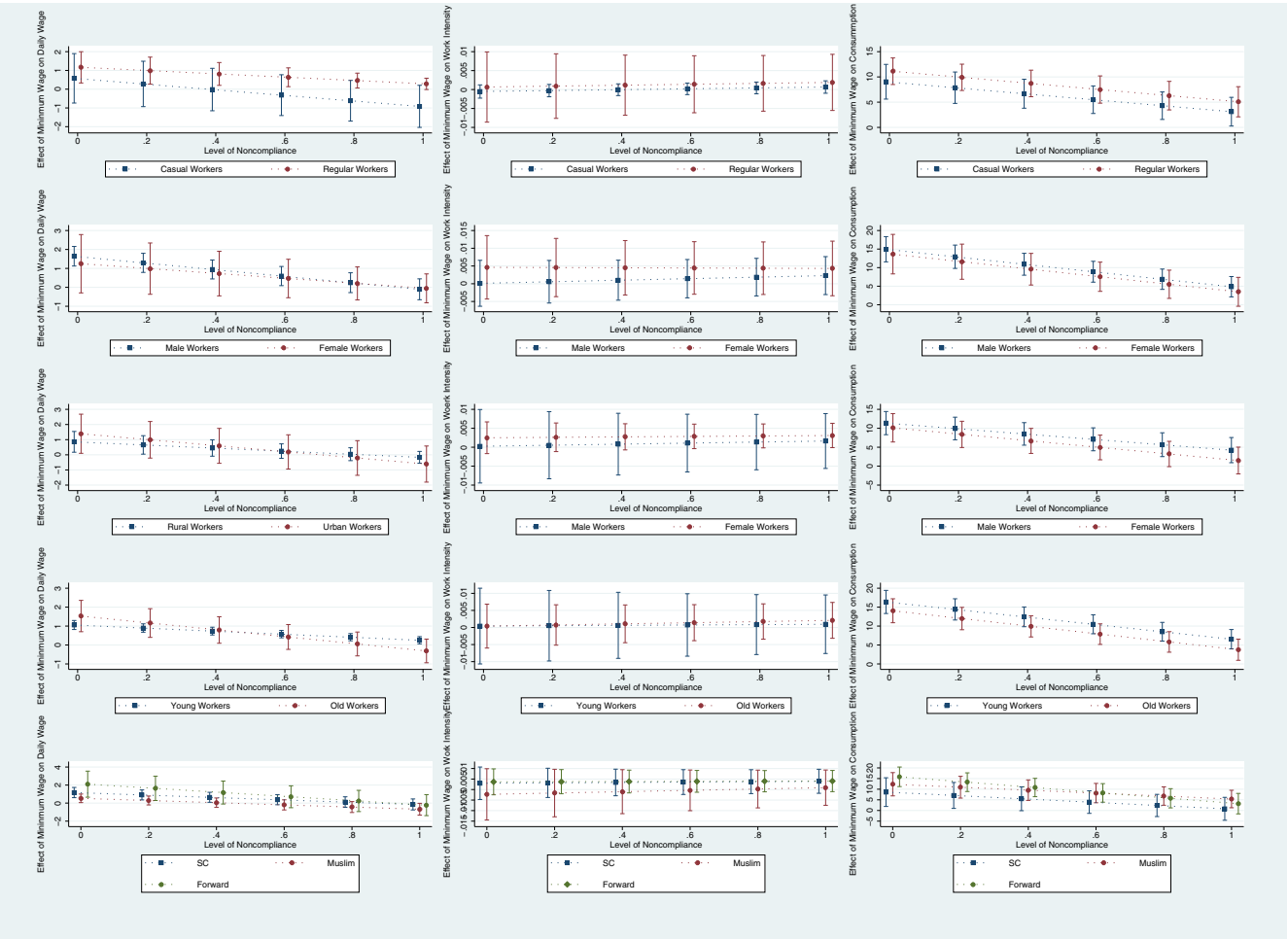

Fig. 3. The marginal effect of the minimum wage on Labour Outcomes evaluated at different level of compliance by subgroups. Source: Authors' own calculations using NSSO data and administrative data from the Report on the Working of the Minimum Wages Act, 1948.Notes: Each column refers to a different two-way fixed effects regression. The dependent variable in the first column is the individual nominal daily wage. The dependent variable in the model estimated in the second column is a measure of weekly work intensity and the dependent variable in the models estimated in the third column is monthly per-capita nominal household consumption. Each row refers to a different sub-group analysis as indicated by the labels on the x-axis. The dots in the graphs represent the marginal of effect of the minimum wage on outcomes evaluated at different levels of compliance. State and year dummies are included in all regressions. Additional covariates include a constant, the logarithm of state population, the logarithm of state GDP, age and its square (in years) and dummy variables for socio-religious status, regular work status, marital status, gender and education level, The vertical lines represent 95% confidence intervals around the point estimate. All regressions are weighted.

compliance rises. The effect of minimum wages on work remains small and insignificant, even after inclusion of state-specific time trends.

d. Endogeneity

The two-way fixed effects approach is commonly used to identify the causal effects of minimum wages. As noted above, this approach relies on a parallel trend assumption to identify causal effects. Our estimation, however has the added complication, that in addition to the minimum wage, we must also deal with potential endogeneity of the compliance measure. It is possible that firms choose whether to comply or not in tandem with their other production decisions (Ashenfelter and Smith (1979), Chang and Ehrlich (1985), Squire and Suthiwart-Narueput (1997), Basu et al. (2010) and Clemens and Strain (2020)); if so the OLS estimator may be biased. We could handle this by extending the parallel trend assumption to assume that the evolution of the outcome variable over time would be the same across states in the absence of either a minimum wage or compliance change.

An alternative approach is to consider using instrumental variables to deal with compliance endogeneity, while continuing to rely on the parallel trend assumption for minimum wages. We use two instruments for noncompliance. The first follows Almeida and Carneiro (2009) and Soundararajan (2019) and uses regional variation in crime rates. They motivate the use of crime rates as an instrument on the basis that states with low crime rates may also have strong institutions to enforce labor laws. A priori, they argue that there is no reason for serious offences such as homicide to be correlated with informal behavior of the firm, such as noncompliance except through third factors that are correlated with general enforcement of the law in the region. The crime data are taken from the Crime in India Annual reports published by the National Crime Records Bureau and refer to the rate of total cognisable crimes per 100,000 of population.[10]

The second instrument we consider is a broad measure of the strength of labour regulation enforcement across states. Since the mid-1990 s the labour inspection system in India has undergone significant reform. Much of this followed complaints from employ-

[10] We have also used narrower classification of crimes involving sexual assault as instruments, which are even less likely to be correlated with underlying economic conditions. We obtained similar results when the narrower classification is used as instruments.

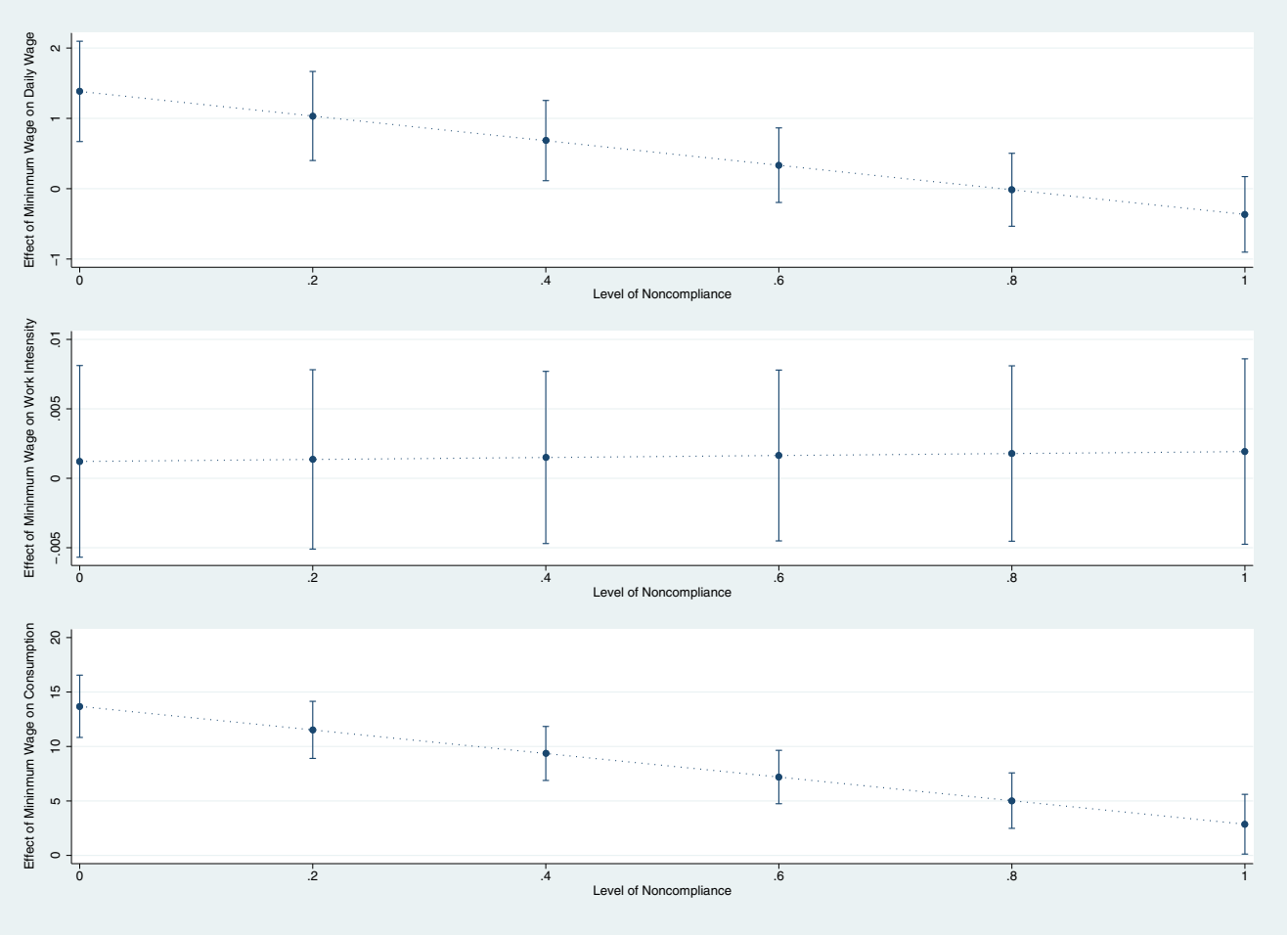

Fig. 4. The marginal effect of the minimum wage on Labour Outcomes evaluated at different level of compliance with an 85% threshold. Source: Authors' own calculations using NSSO data and administrative data from the Report on the Working of the Minimum Wages Act, 1948. Notes: Each panel refers to a different two-way fixed effects regression using 85% of the minimum wage to determine compliance. The dependent variable in the model in the top panel is the individual nominal daily wage. The dependent variable in the model estimated in the middle panel is a measure of weekly work intensity and the dependent variable in the models estimated in the bottom panel is monthly per-capita nominal household consumption. The dots in the graphs represent the marginal of effect of the minimum wage on outcomes evaluated at different levels of compliance. State and year dummies are included in all regressions. Additional covariates include a constant, the logarithm of state population, the logarithm of state GDP, age and its square (in years) and dummy variables for socio-religious status, regular work status, marital status, gender and education level. All regressions are weighted. The vertical lines represent 95% confidence intervals around the point estimate.

Table 6
The effects of Minimum Wages and Compliance on Labour Market outcomes with State-Specific Time Trends.

	(1) Nominal Daily Wage	(2) Nominal Daily Wage	(3) Weekly Work Intensity	(4) Weekly Work Intensity	(5) Nominal Monthly per capita Consumption	(6) Nominal Monthly per capita Consumption
Minimum Wage	−0.0380	2.515*	0.00790	0.00919	3.042	17.98***
	(0.736)	(1.210)	(0.00504)	(0.0106)	(3.129)	(1.803)
NC_0	5.694	148.8***	−0.884*	−0.812	−87.90	749.5***
	(50.14)	(38.45)	(0.389)	(0.517)	(218.2)	(164.3)
Minimum Wage # NC_0		−2.483**		−0.00126		−14.52***
		(0.805)		(0.00669)		(1.358)
N	179,337	179,337	179,337	179,337	179,336	179,336

Source: Authors' own calculations using NSSO data and administrative data from the Report on the Working of the Minimum Wages Act, 1948.
Notes: Each column presents a seperate two-way fixed effects regression. The dependent variable in the model estimated in columns 1 and 2 is the individual nominal daily wage. The dependent variable in the models estimated in columns 3 and 4 is a measure of weekly work intensity and the dependent variable in the models estimated in columns 5 and 6 is monthly per-capita nominal household consumption. Clustered standard errors by state in parentheses. State and year dummies are included in all regressions. All regressions also include state-specific time trends. Additional covariates include a constant, the logarithm of state population, the logarithm of state GDP, age and its square (in years) and dummy variables for socio-religious status, regular work status, marital status, gender, urban residence and education level, All regressions are weighted.
$^{+}$ $p < .1$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 7
First Stage IV Regression for compliance.

	(1) NC_0(Unclustered SEs)(Clustered SEs)	(2) Minimum Wages # NC_0(Unclustered SEs)(Clustered SEs)
State Crime Rate	−0.00006	0.267
	(7.00e-06)	(0.001)
	(0.0006)	(0.084)
State Crime Rate#Minimum Wage	0.000003	−0.00097
	(4.02e-08)	(6.00e-05)
	(0.000003)	(0.0005
Enforcement	0.0022	0.120
	(0.00002)	(0.0034)
	(0.00136)	(0.143)
Enforcement#Minimum Wage	−0.0000	−0.00187
	(2.00e-07)	(0.00004)
	(0.000014	(0.002)
F-statistic for exclusion restrictions		
Unclustered	3409	21,116
Clustered	1.45	3.42
N	161,298	161,298

Source: Authors' own calculations using NSSO data and administrative data from the Report on the Working of the Minimum Wages Act, 1948.
Notes: Each column presents a seperate two-way fixed effects regression. The dependent variable in the model estimated in column 1 is the state compliance rate and the dependent variable in the model estimated in column 2 is the state compliance rate interacted with the state minimum wage rate. Non-clustered and Clustered standard errors by state in parentheses. State and year dummies are included in all regressions. All other conditionally exogenous variables are included as regressors in the first stage including, the state level minimum wage, the logarithm of state population, the logarithm of state GDP, age and its square (in years) and dummy variables for socio-religious status, regular work status, marital status, gender, urban residence and education level. The State crime rate and state inspection rate are used as instruments and included in the first stage regressions. All regressions are weighted.
$^{+}$ $p < .1$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 8
Instrumental Variable estimate of the effects of Minimum Wages and Compliance on Labour Market outcomes.

	(1) Nominal Daily Wage	(2) Weekly Work Intensity	(3) Nominal Monthly per capita Consumption
Minimum Wage	0.461	0.00919	11.87**
	(0.718)	(0.0121)	(3.831)
NC_0	257.3*	−2.505	357.1
	(131.2)	(2.016)	(823.7)
Minimum Wage # NC_0	−1.337**	0.00269	−7.001***
	(0.497)	(0.00671)	(1.247)
constant	−405.8	8.717	−260.4
	(522.5)	(9.671)	(2937.1)
N	161,298	161,298	161,297

Source: Authors' own calculations using NSSO data and administrative data from the Report on the Working of the Minimum Wages Act, 1948.
Notes: Each column presents a seperate two-way fixed effects Instrumental Variable regression. The dependent variable in the model estimated in column 1 is the individual nominal daily wage. The dependent variable in the model estimated in column 2 is a measure of weekly work intensity and the dependent variable in the model estimated in column 3 is monthly per-capita nominal household consumption. Clustered standard errors by state in parentheses. State and year dummies are included in all regressions. Additional covariates include a constant, the logarithm of state population, the logarithm of state GDP, age and its square (in years) and dummy variables for socio-religious status, regular work status, marital status, gender, urban residence and education level. IV specification uses the state crime rate and state inspection rate as instruments. All regressions are weighted.
$^{+}$ $p < .1$, * $p < .05$, ** $p < .01$, *** $p < .001$

ers that the existing system amounted to harassment of employers, with then Prime Minister Vajpayee conjuring the emotive image of ''Inspector Raj". This has led some to argue that the reforms were motivated by political ideology rather than underlying economic circumstances (Sundar (2010)). The reforms have seen an increased emphasis on random, rather than targeted, inspections and the end result has been substantial variation in the scope and coverage of labour inspections across the states, for reasons that have little to do with existing underlying compliance rates. We exploit this variation in the timing and intensity of reforms across states, using the number of inspections (per 10,000 workers) in each state at time t, as an instrument for noncompliance. The results from the first stage are given in Table 7.

The first stage marginal effects on the instruments are as expected; at the average value of the minimum wage, higher crime is associated with more noncompliance and more inspections are associated with less noncompliance. The F-statistic on the instruments in the first stage are 3409 and 21,116 for the direct noncompliance measure and the interaction term respectively, when unclustered standard errors are used, suggesting the instruments are relevant. However, these fall to 1.45 and 3.42 when the conservative cluster robust standard errors are used in the first stage. The decline in the F-statistics following clustering is to be expected since our instruments vary mostly at the state level, but nevertheless raises concerns over weak instruments. It is important to acknowledge this as an important limitation of the instrumental variable approached used in this section.

The results of the second stage instrumental variable estimation are given in Table 8. Even after accounting for potential endogeneity, the estimated effects on wages and consumption are similar to

Table 9
Pairwise estimates: Daily Wage Regression.

	(1) Overall Effect	(2) Simple Mean	(3) Weighted Mean
	Nominal Daily Wage		
Minimum Wage	1.93	2.83	2.87
Minimum Wage#NC_0	−2.10	−0.04	−2.19
	Weekly Work Intensity		
Minimum Wage	0.002	-0.0278	0.004
Minimum Wage#NC_0	0.012	0.0347	0.002
	Nominal Consumption		
Minimum Wage	14.50	19.52	17.35
Minimum Wage#NC_0	−13.93	−1.33	−13.91

Source: Authors' own calculations using NSSO data and administrative data from the Report on the Working of the Minimum Wages Act, 1948.
Notes: Each panel represents a separate two-way fixed effect regression. In the top panel the dependent variable is the individual nominal daily wage. In the middle panel the dependent variable is work intensity, while in the bottom panel the dependent variable is per-capita nominal household consumption. The results in Column 1 are the two-way fixed effects using all states. The second column is the simple average of the estimated coefficients across all pairwise two-way fixed effects using only two states and four years per regression. The third column is a weighted average of the estimated coefficients across all pairwise two-way fixed effects using only two states and four years per regression, where the weights are the inverse of the estimated standard errors on each estimate in each regression. All regressions include State and year dummies. Additional covariates include a constant, the logarithm of state population, the logarithm of state GDP, age and its square (in years) and dummy variables for socio-religious status, regular work status, marital status, gender, urban residence and education level. All regressions are weighted.
$^{+}$ $p < .1$, * $p < .05$, ** $p < .01$, *** $p < .001$.

those presented earlier, although the coefficients are less precisely estimated. The direct effect of minimum wages on daily wages and consumption is positive, while the interaction term shows that these effects are weaker in high noncompliance regimes. The minimum wage effects on employment remain very small and statistically insignificant. While these results are reassuring, in the absence of stronger instruments, it is best to view these results as approximating the causal effects of compliance on labour market outcomes.

e. Pairwise state contributions to overall Effect.

In an influential paper Goodman-Bacon (2019) shows, that any two-way fixed effects estimate, using a binary treatment, can be decomposed into a weighted average of all possible two-by-two difference-in-differences estimators that can be constructed from the panel data set. This decomposition is important in that it highlights which state comparisons are effectively being used to obtain identification and explicitly links the underlying variation in the data to the final estimate (see also Angrist (1991) and de Chaisemartin and D'Hailtfoeuille (2020)).

This result extends to a continuous treatment variable, such as that used in our paper. With a balanced sample and equal samples in each group, the overall estimate from the canonical difference in difference estimator with a continuous treatment is a weighted average of all possible pairwise fixed effects possible, by choosing two states and two time periods from the sample of states and years in the data. The weights are the squared difference in difference estimates from a first stage regression where the treatment variable (in our case the minimum wage) is used as the dependent variable; pairwise comparisons that yield larger treatments receive larger weights. In the extended model given by (2), the decomposition is more complicated in that identification of all the parameters requires at least 4 time periods. As we only have four years available the underlying contributions to the overall effect will involve pairwise comparison of states using all four years of data for each state. Furthermore, unequal sample sizes across states and years are also likely to affect the weights. Nevertheless, in the spirit of Goodman-Bacon, we feel it is useful to explore the individual contributions of pairwise state comparisons to our overall estimates. This will allow us to determine if the final estimate is being driven by a specific component of the overall variation in the data.

For reasons discussed above we restrict our sample in this section to the balanced sample of states over the 4 years of our sample. We then estimate model (2) for every pairwise state comparison using all four years of data for each state. Since we have 10 states in our balanced sample this results in 45 potential pairwise state comparisons and thus 45 separate estimates of each parameter. As well as the parameter estimate we also keep account of the standard error of each estimate. We speculate that the standard error is likely to be an important proxy for the relevant weight in each pairwise comparison, in the same way that the first stage treatment effect determines the weight in the canonical model. The results from this exercise are given in Table 9.

The first column of Table 9 shows the main minimum wage effect and the interaction effect on daily wages, work intensity and consumption for our balanced sample of states. The results are in keeping with those reported earlier for our full unbalanced sample. The second column reports the simple mean across the 45 pairwise comparisons. It is clear from this that the simple average bears little relationship to the overall effect. The simple average of the interaction in the wage equation is almost zero, implying no variation in effect across compliance regimes, while the simple average of the direct minimum wage effect is incorrectly signed in the work equation. In the third column we report a weighted average of the pairwise estimates, where the weights are the inverse of the estimated standard errors. While not exact, the weighted averages across the 45 pairwise comparisons are now similar to the overall estimates.

To explore this in more detail Fig. 5 plots the weighted kernel density estimates of the 45 pairwise estimates for the minimum wage effect and the interaction effect, where the vertical line denotes the overall aggregate two-way estimate. It clear from these graphs that the mode of the weighted distribution is very close to the overall effect in all cases. The overall effects we report in this paper are not driven by a small number of unusual pair-wise comparisons.

f. Analysis by skill category

In the analysis thus far, we have used aggregated state-wide noncompliance rates. This is useful in comparing our work to previous studies and in allowing for the use of state level instruments when correcting for endogeneity. However, the aggregation

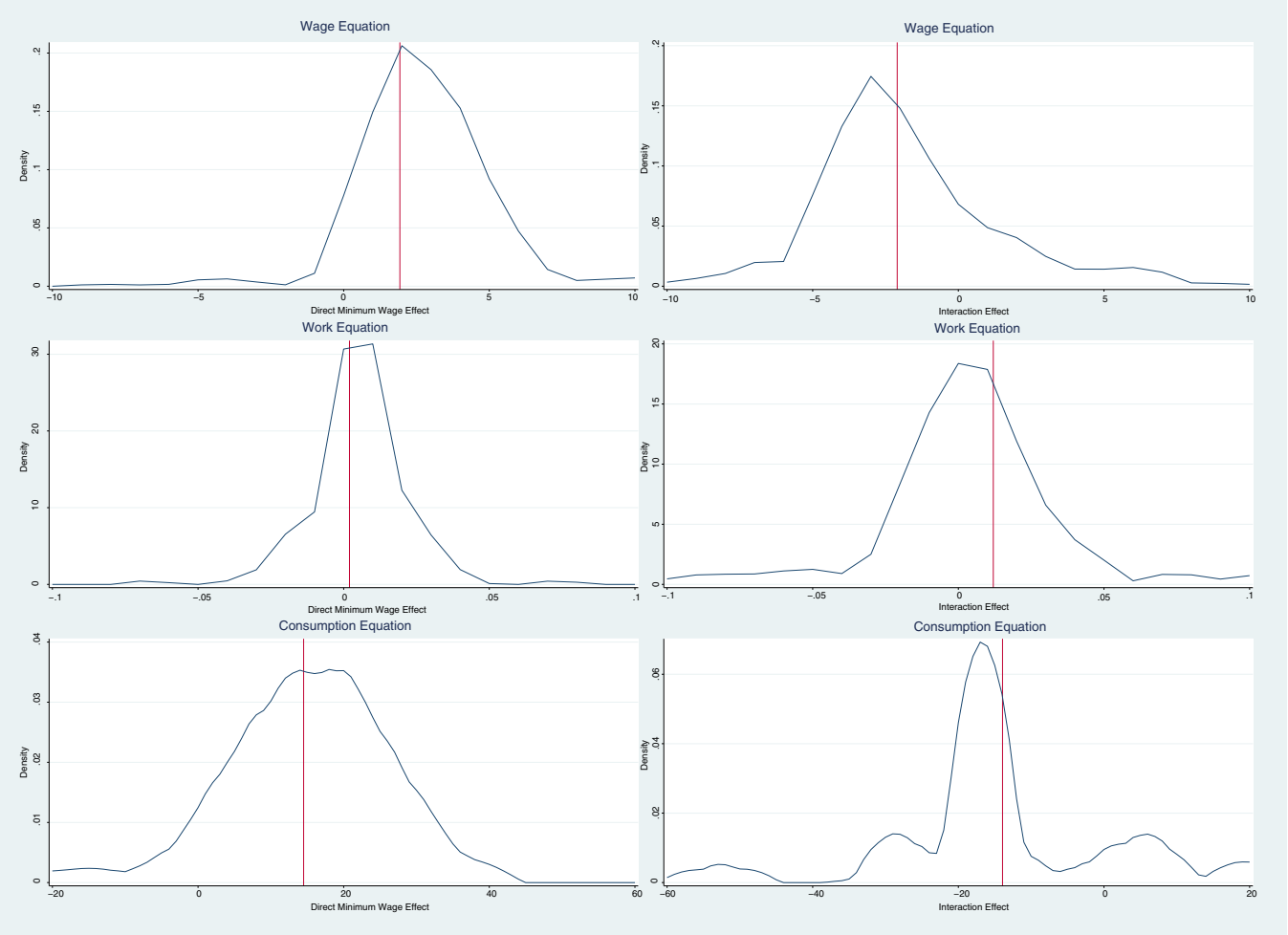

Fig. 5. Weighted Density of pairwise estimates of the Direct and Interaction effect of Minimum wages on Labour Outcomes. Source: Authors' own calculations using NSSO data and administrative data from the Report on the Working of the Minimum Wages Act, 1948. Notes: The graph shows estimated weighted kernel density estimates of the distribution of the direct and interaction effect of minimum wages on labour outcomes across all pairwise comparison of states in our sample. Each row corresponds to a different labour outcome. The dependent variable in the first row is the individual nominal daily wage. The dependent variable in the model estimated in the second row is a measure of weekly work intensity and the dependent variable in the models estimated in the third row is monthly per-capita nominal household consumption Each point corresponds to the estimated coefficient in the pairwise two-way fixed effects regression using only two states per regression,. All regressions include State and year dummies. Additional covariates include a constant, the logarithm of state population, the logarithm of state GDP, age and its square (in years) and dummy variables for socio-religious status, regular work status, marital status, gender, urban residence and education level, All regressions are weighted. In estimating the density the inverse of the estimated standard errors on each estimate in each regression are used as weights. The vertical lines correspond to the point estimate from the two-way fixed-effect model using all states in the balanced sample.

involves throwing away variation in minimum wages and compliance rates across industries and skill categories within a state, that could be potentially useful in identifying the minimum wage effects. To examine this, we consider extending the model to allow for variation across worker characteristics. In particular, we estimate

$$Y_{ict} = \beta_0 + \beta_1 MW_{ct} + \beta_2 NC_{\alpha ct} + \beta_3 MW_{ct} * NC_{\alpha ct} + \beta_4 Z_{st} + \beta_5 D_c + \beta_6 D_t + \varepsilon_{ict} \quad (4)$$

where c refers to the distinct category of worker based on state of residence, industry, education, gender and urban status. In total we have 1288 such skill categories. Identification using equation (4) requires the somewhat stronger assumption of parallel trends across worker categories. Nevertheless, it is useful to see if the disaggregated analysis supports our state-wide analysis. The results are given in Table 10.

For both daily wages and consumption, the results are very similar to those reported at the state level. Both wages and consumption rise with the minimum wage, but this effect is offset by noncompliance. The magnitudes are similar to those estimated at the state level. For example, the analysis using variation across worker categories implies that a worker in a labour market, with noncompliance rates of 70% would only receive 31 paise for each rupee increase (the comparable estimate using state variation was 28 paise). As with the state-level analysis we find little evidence of an impact of minimum wages on employment.

Table 10
The effects of Minimum Wages and Compliance on Labour Market outcomes using variation in minimum wage and compliance by Skill category.

	(1) Nominal Daily Wage	(2) Nominal Daily Wage	(3) Weekly Work Intensity	(4) Weekly Work Intensity	(5) Nominal Monthly per capita Consumption	(6) Nominal Monthly per capita Consumption
Minimum Wage	0.769***	1.683***	0.000220	−0.000128	4.392***	8.373***
	(0.150)	(0.154)	(0.000587)	(0.000681)	(0.600)	(0.725)
NC_0	−29.34**	144.7***	−0.265***	−0.332**	−1.340	757.0***
	(11.21)	(15.99)	(0.0760)	(0.111)	(56.68)	(100.5)
Minimum Wage#NC_0		−1.968***		0.000750		−8.576***
		(0.141)		(0.000917)		(0.799)
constant	−128.3	266.3	1.252	1.102	−3720.0**	−2000.9
	(186.2)	(162.7)	(2.150)	(2.145)	(1136.9)	(1123.2)
N	179,363	179,363	179,363	179,363	179,362	179,362

Source: Authors' own calculations using NSSO data and administrative data from the Report on the Working of the Minimum Wages Act, 1948.
Notes: Each column presents a seperate two-way fixed effects regression. The dependent variable in the models estimated in columns 1 and 2 is the individual nominal daily wage. The dependent variable in the models estimated in columns 3 and 4 is a measure of weekly work intensity and the dependent variable in the models estimated in columns 5 and 6 is monthly per-capita nominal household consumption The minimum wage and compliance variable is constructed for distinct categories of worker based on state of residence, industry, education, gender and urban status. State and year dummies are included in all regressions. Additional covariates include a constant, the logarithm of state population and the logarithm of state GDP. . Clustered standard errors by state in parentheses. All regressions are weighted.
$^{+}$ $p < .1$, * $p < .05$, ** $p < .01$, *** $p < .001$.

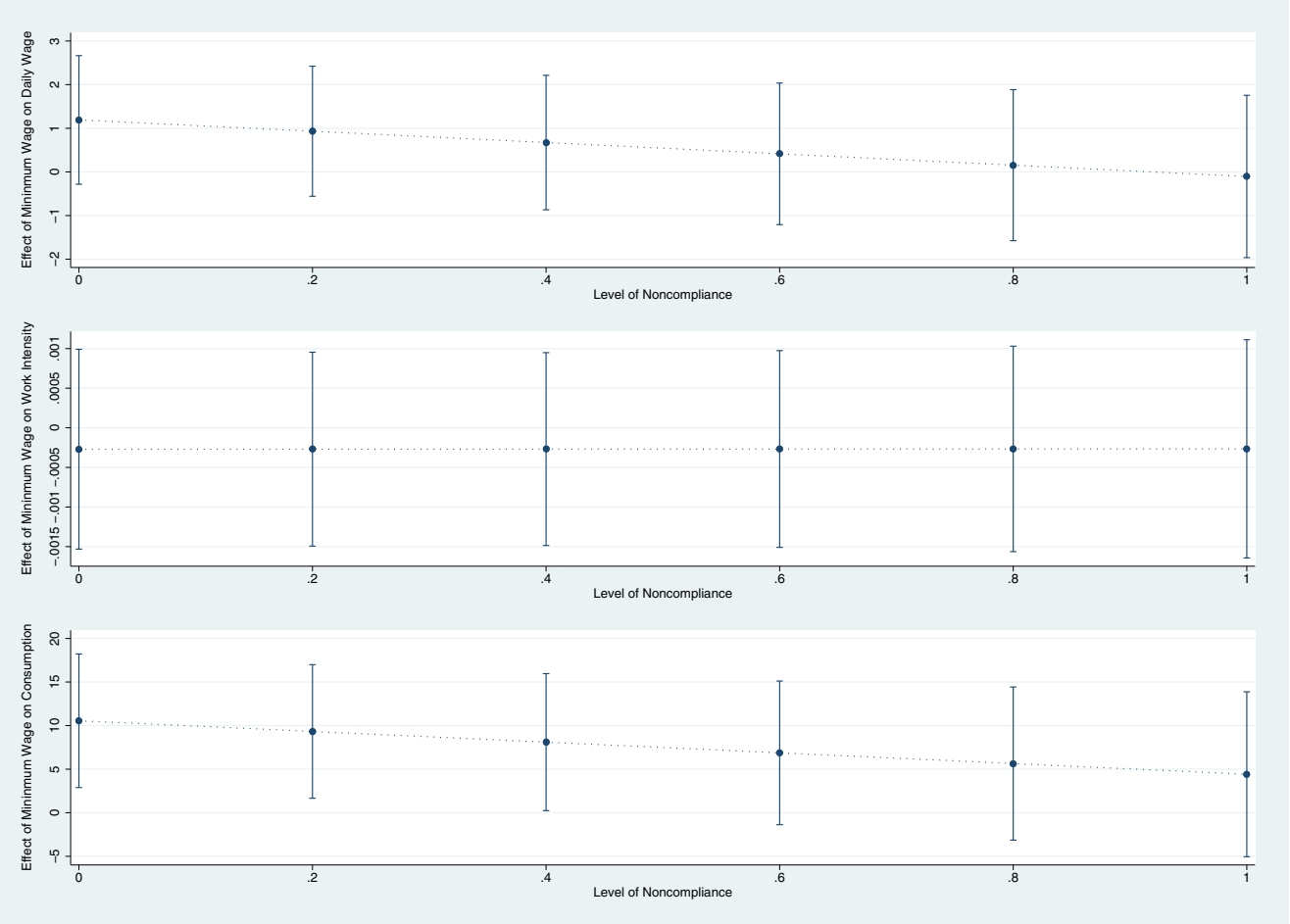

Fig. 6. The marginal effect of the minimum wage on Labour Outcomes in the Uncovered Sector evaluated at different level of compliance. Source: Authors' own calculations using NSSO data and administrative data from the Report on the Working of the Minimum Wages Act, 1948. Notes: Each panel refers to a different two-way fixed effects regression estimated on the sample of wage earners not covered by the minimum wage legislation.. The dependent variable in the model in the top panel is the individual nominal daily wage. The dependent variable in the model estimated in the middle panel is a measure of weekly work intensity and the dependent variable in the models estimated in the bottom panel is monthly per-capita nominal household consumption.. The dots in the graphs represent the marginal of effect of the minimum wage on outcomes evaluated at different levels of compliance. State and year dummies are included in all regressions. Additional covariates include a constant, the logarithm of state population, the logarithm of state GDP, age and its square (in years) and dummy variables for socio-religious status, regular work status, marital status, gender and education level. All regressions are weighted. The vertical lines represent 95% confidence intervals around the point estimate.

g. The impact of minimum wages in the uncovered sector

All of our analysis to date has focused on workers that are legally covered by the minimum wage. However, there is a body of literature that suggests that high minimum wages in the covered sector may also have an effect on uncovered workers. Ham (2018) finds that minimum wages in developing countries may change the distribution of workers across sectors instead of destroying jobs. Likewise, Boeri, Garibaldi, and Ribeiro (2011) discuss the "lighthouse effect" whereby a statutory minimum wage in the covered sector acts as a signal to the informal sector. As noted earlier the structuring of the minimum wage in India is somewhat different to other countries in that the law targets informal casual labour. Thus the usual distinction between a regulated formal covered sector and an unregulated informal uncovered sector is not applicable to India. Nevertheless it still possible that a higher statutory minimum wage for informal labour may lead to spillover effects for uncovered formal workers. To examine this we re-estimate equation (2) considering only workers in the uncovered sector. Specifically labour market outcomes for workers in the uncovered sectors are regressed on the state-wide minimum wage and compliance figures constructed using workers in the covered sector. The results are given in Fig. 6.

Looking at the effect of the minimum wage on wages and consumption we see that the direction of the effects are similar to that reported in the covered sector. The results suggest a positive pass through of legislated minimum wages to daily wages and consumption in the uncovered sector, which is mitigated by noncompliance. However, in comparison to the effects we find for the covered sector the size of the minimum wage effects in the uncovered sector are smaller and in many cases not statistically significant. In keeping with the results for employment reported earlier for the covered sector we find no evidence of a minimum wage effect on employment in the uncovered sector. The lack of employment effects reported earlier are not the result of changing composition between the covered and uncovered sectors.[11]

7. Conclusion

Minimum wages are increasingly being used in developing countries as a policy measure to combat exploitation of workers and raise living standards. However, such legislation can only be effective if enforced correctly. Simply legislating for a minimum wage is not enough to make it happen. In many developing countries there is a substantial difference between de jure and de facto regulation. Using a unique data set that contains information on over 1500 minimum wages across occupations, we find that noncompliance is a key feature of the Indian labour market, with noncompliance rates as high as 90% for some class of workers.

We examine the consequences of imperfect compliance by looking at the heterogenous effects of minimum wages across compliance regimes in India from 1999 to 2011. We show that minimum wages have a positive effect on wages, with no evidence of a corresponding effect on wage-earning employment. As a result, these higher wages translate into higher consumption. However, compliance matters. The beneficial pass-through of higher minimum wages to wages and consumption is mitigated in low compliance regimes.

Given these results it is essential that labor market reform includes effective regulation and enforcement regimes. Such initiatives may include a reversal of the relaxation of labour market inspections that has occurred in recent years, developing a more effective system of penalties and sanctions and further developing the role of government as an employer of last resort. Only once these issues are addressed will workers fully recoup the benefits of higher minimum wages.

[11] As a placebo test we re-estimated equation (2) using only workers in the top 30% of the uncovered wage distribution in each state. While spillovers are possible we would not expect them to extend this far up the uncovered distribution. When we re-estimate our model on this subsample, the minimum wage and compliance effects on wages are small and none are precisely estimated. While this is not a definitive test, it is reassuring that our specification fails to find minimum wage effects in the parts of the distribution (high wage uncovered workers) where one would not expect such effects.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

Mapping of Administrative Minimum Wage Data to 3 Digit Industry Code

The report on the Working of the Minimum Wages Act, 1948 published annually from the Labour Bureau India, provides data on the minimum wages which have been fixed for different 'schedules of employment' in states. A schedule of employment refers to an employment specified in the schedule appended to the Minimum Wages Act or any process or branch of work forming part of such employment. For example, agarbatti manufacturing, aerated water manufacturing, bidi making, biscuits manufacturing are such schedules of employment for which minimum wages have been fixed in different states.

The schedules of employment are not recorded in terms of industrial classification in the report. However, in the survey data of NSS rounds, every worker is assigned an industry code of her employment at the most detailed 5-digit level. Since we are interested in estimating compliance with the minimum wages, it is important to uniquely identify the minimum wage applicable to each worker as per industry code of her employment. In order to do so, we have developed a mapping whereby we assign each schedule of employment a relevant NIC code as close as possible. Though this was a time-consuming task which involved manually examining all schedule of employments and assigning them to an appropriate NIC code, we were able to complete the mapping for more than 95 percent of schedules of employment. For those schedules we could not find a relevant NIC code, we first looked for a relevant NCO (National Occupational Code) code, and if not found, we dropped those schedules from our analysis.

The following examples illustrate our mapping. For example, in our mapping the schedule of employment called "agarbatti manufacturing" is assigned to NIC code 20238 in the NSS labelled "Manufacture of "agarbatti" and other preparations which operate by burning" , while the schedule of employment called "Bidi Making"

was assigned NIC code 12002 which is labelled "Manufacture of bidi".

Schedules of employment	NIC code	NIC Description
Agarbatti Manufacturing	20238	Manufacture of "agarbatti" and other preparations which operate by burning
Aerated water manufacturing	11041	Manufacture of aerated drinks
Bidi making	12002	Manufacture of bidi
Biscuits manufacturing	10712	Manufacture of biscuits, cakes, pastries, rusks etc.

The Stata do-files which create this mapping for all schedule of employments are available from the authors upon request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.worlddev.2021.105653.

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