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Minimum Wage and Labour Market Dynamics in Pakistan*

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Abstract

Public support for raising minimum wages as a policy response to economic inequality is increasing; however, empirical evidence from highly informal and weakly regulated labour markets remains limited. This study estimates the impact of minimum wage increases on earnings and hours worked in Pakistan, drawing on 21 waves of nationally representative Labour Force Survey data between 1992 and 2021. By leveraging national time variation in statutory minimum wages and pre-policy district exposure, proxied by the proportion of workers earning below the minimum wage prior to policy changes, we find that increases in the minimum wage are associated with statistically significant but modest gains in real hourly earnings, with stronger wage pass-through observed in local labour markets with higher initial exposure. The benefits are disproportionately greater for male workers; however, the policy has achieved only limited and uneven progress in reducing gender pay disparities. On the intensive margin, minimum wage increases are associated with reductions in hours worked, particularly among women. This pattern is consistent with adjustment through hours in segments characterised by part-time work and weaker compliance. Overall, the findings indicate that minimum wage policy can increase earnings in low-wage areas under conditions of partial compliance, yet has limited capacity to address persistent structural gender inequality in highly informal contexts. These results underscore the need for stronger enforcement and complementary, gender-sensitive labour market interventions.

Keywords: minimum wage, hourly earnings, hours worked

JEL Codes: J22, J31, J38

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1 Introduction

The minimum wage is a key labour market intervention aimed at reducing income inequality, alleviating poverty, and improving the welfare of low-paid and vulnerable workers. Its legitimacy primarily derives from distributional objectives and evidence that, in imperfect and frictional labour markets, moderate minimum wages raise wages without clear or robust job losses (Manning, 2021). However, empirical evidence is still disproportionately concentrated in developed countries, particularly the United States, with relatively few studies dedicated to low- and middle-income economies characterised by high informality and weak enforcement (Martínez and Martínez, 2021; Neumark, 2019). This imbalance raises concerns about the external validity of these findings, especially for developing countries where labour markets are characterised by high informality, weak enforcement mechanisms, and limited social protection.

The empirical literature from high-income countries has generally found that minimum wage policies tend to raise earnings for low-paid workers with modest effects on employment (Belman and Wolfson, 2014; Dube and Zipperer, 2024).[1] For instance, a meta-analysis by Dube and Zipperer (2024) covering 88 studies reports a median own-wage elasticity of employment close to -0.13, indicating limited job losses. Similarly, studies from Germany (Bossler and Schank, 2023) and the UK (Robinson, 2005) have found that minimum wage increases reduce wage inequality, particularly at the lower end of the distribution. In developing countries, evidence remains more contested. Pérez (2020) find that in Colombia, a 10% increase in the minimum wage raises formal sector wages by 3% and informal sector wages by 1%, indicating partial compliance and spillover effects. While no significant employment effects are detected in the formal sector, the study finds small negative employment effects in the informal sector, suggesting that minimum wage adjustments can affect employment margins in segmented labour markets. Comparable studies from Brazil (Saltiel and Urzúa, 2022), Ecuador (Wong, 2019), Nicaragua (Alaniz et al., 2011), and South Africa (Bassier and Ranchhod, 2024) document substantial heterogeneity in both wage and employment responses, with effects concentrated among workers and sectors more exposed to minimum wage increases. While these studies consistently document wage gains at the bottom of the distribution, both wage and employment effects vary across worker groups,

[1] A sequence of studies recognises the distributional effects of minimum wage policies. Supportive evidence can be found in Grossman (1983), who argued that minimum wage changes in the US significantly affect workers at the lower end of the wage distribution more than those at the top. The reason is that low-paid workers, near the mandated minimum wage, could experience the most significant relative and absolute wage increase. This can be true for low-paid workers in Pakistan as well. Relatedly, Machin et al. (2003) documented a 6% increase in average hourly wages for care home workers, among the lowest-paid occupations in the UK, after the minimum wage introduction in 1999. Ashenfelter and Jurajda (2022) measured the minimum wage pass-through to wages to be 0.7 among workers in the US fast food industry. Cengiz et al. (2019) provided an estimate of the effect of the minimum wage policy on the average hourly wage of 6.8% using a difference-in-differences event study approach.

with outcomes depending on exposure to the minimum wage, compliance, sectoral coverage, and institutional context. This evidence highlights the redistributive potential of minimum wage policy in economies with large informal or segmented labour markets, while also underscoring the limits of external validity and the importance of country-specific analysis that accounts for enforcement capacity, labour market segmentation, and worker heterogeneity.

Pakistan provides a particularly relevant and underexplored context. Since its introduction in 1961, the minimum wage has been featured as a central income enhancement policy. After stagnating in real terms between 1960 and 1991, the real minimum wage began to rise steadily from 1992 onward, with notable increases post-2008. Yet, despite its longstanding presence, systematic evaluations of the policy's effectiveness are scarce. This paper addresses that gap by examining the impact of minimum wage policy on labour market outcomes in Pakistan, focusing on three interrelated questions. First, do minimum wage increases effectively raise earnings for low-paid workers? Second, how do such policies affect hours worked? Third, to what extent do they contribute to reducing gender wage disparities in a context marked by significant and persistent inequality?

Pakistan's labour market is institutionally distinct from that of most developed economies. There is no unemployment insurance, labour unions are weak, and the state provides few welfare guarantees. These challenges are compounded by a vast informal sector and widespread poverty, which limit the enforceability of labour regulations. With high firing costs in the formal sector (Ahmed et al., 2014), and minimal social safety nets, minimum wage policy functions as a de facto anti-poverty measure (Samutpradit, 2024). Evaluating its distributional and heterogeneous effects is particularly important given that a substantial share of the workforce earns at or near the minimum wage, often within informal or semi-formal employment arrangements.

In this paper, we study the effects of Pakistan's minimum wage policy on wages and hours worked using Labour Force Survey (LFS) data from 1992 to 2021 and focus on working-age adults (15–64). Our empirical approach identifies the effects by exploiting national time variation in the statutory minimum wage interacted with pre-policy differences across districts in the share of workers earning below the minimum wage.

Given the well-documented gender wage gap in Pakistan—estimated at 34% in 2018 and 18% in 2021 (International Labour Organization, 2018; World Bank, 2024b)—we further examine whether minimum wage policy has heterogeneous wage effects by gender and whether it is associated with changes in gender wage disparities[2]. Female workers are disproportionately concentrated in low-wage occupations, contributing to a persistent 'sticky floor' in the earnings

[2] See Appendix A.3 for stylised facts from the Labour Force Survey on gender and education gaps.

distribution (Card et al., 2016; Kahn, 2015). As a result, minimum wage increases may have differential effects by gender. While evidence from high-income countries suggests that minimum wages can reduce gender wage gaps (Caliendo and Wittbrodt, 2022; Oliveira, 2023; Robinson, 2005; DiNardo et al., 1996), findings from developing economies are more mixed. For example, Wong (2019) document smaller wage gains for women in Ecuador, while Davalos et al. (2020) highlight how informality and weak enforcement dilute gender-equalising effects. We provide new evidence from Pakistan, where these institutional features are particularly salient.

Our findings, from over two decades of labour force surveys, suggest that minimum wage increases in Pakistan have economically modest but robust effects on average earnings, with stronger pass-through in more exposed local labour markets, but are ineffective in reducing gender pay disparities, as women experience weaker wage pass-through. These patterns remain robust in district-level analyses that exploit variation in enforcement intensity. These results echo prior studies that highlight the redistributive potential of minimum wage policy but question its sufficiency as a tool for promoting gender equity.

By examining heterogeneous effects across demographic groups and labour market segments, this study contributes to a more nuanced understanding of how wage regulation operates in low-income, high-informality economies. Consistent with the broader literature, we find little evidence that minimum wage increases induce substantial labour supply responses: adjustments in hours worked are small for women, suggesting that policy effects operate primarily through wages rather than reductions in working time (Sabia, 2009; Jardim et al., 2022; Bossler et al., 2026; Gindling and Terrell, 2007).

This paper contributes to the literature by providing the first long-run evidence on minimum wage effects in Pakistan, a setting characterised by high informality and weak enforcement, and by examining heterogeneity across gender, exposure, and labour market segments. The remainder of this paper is organised as follows. Section 2 describes the implementation of minimum wages in Pakistan, and the dynamics of wages and emphasises the existing gap between male and female workers. Section 3 presents the Labour Force Survey data and the construction of variables. Section 4 describes the empirical strategy and key findings. Section 5 concludes.

2 Minimum wages in Pakistan: Institutional Context

Overview Pakistan introduced its first constitutional law on minimum wages in 1961 with the, *Minimum Wages Ordinance 1961*, which was later extended and renamed the Minimum Wage Rules 1962. Before the separation of East Pakistan (now Bangladesh) in 1971, Pakistan operated a

complex minimum wage system, characterised by separate legislation for different sectors. The Minimum Wage Ordinance 1961 was subsequently renamed the West Pakistan Minimum Wages for Unskilled Workers Ordinance 1969 (Bano, 2018). The initial fragmentation of economic sectors has had enduring effects, leading to the continued existence of occupation- and industry-specific wage schedules that remain administratively linked to the unskilled wage floor.

Before 2010, the Federal Government of Pakistan was responsible for setting the minimum wages for workers. Since 2010, the 18th Amendment to the Constitution shifted the responsibility for setting minimum wages to the provinces[3]. However, the federal government continues to oversee this function for the Islamabad Capital Territory (ICT). Each province has Minimum Wage Boards, established under the 1961 Minimum Wage Ordinance or similar provincial laws, which provide recommendations based on factors such as economic trends, living costs, and other considerations. Legally, Minimum Wage Boards can recommend wage rates, but the authority to officially declare minimum wages through a notification in the gazette lies with the provincial governments or, for the ICT, the federal government. Wage setting is highly centralised in practice, as provincial boards generally adhere to federal government decisions instead of setting independent wage trajectories. Nonetheless, provinces typically look to the federal budget for direction and adjust their minimum wage rates accordingly (International Labour Organization, 2016).

The wage floor is typically defined in Pakistani Rupees (PKR) per month. We focus on the official federal minimum wage for unskilled workers in Pakistan. The provincial minimum wage rates are closely aligned with the wages set by the federal government. Industry- and occupation-specific minimum wages are typically expressed as fixed multiples of the unskilled wage and adjusted mechanically when the federal minimum is revised. Under the Minimum Wages Ordinance, 1961, provincial governments can also set industry-specific minimum wage rates within their jurisdictions, following recommendations by Provincial Minimum Wages Boards.

One key feature of minimum wage legislation in Pakistan is that it covers all workers in industry and commercial establishments. However, it does not cover public sector employees, agricultural workers, coal miners, workers in charitable enterprises, and small enterprises that employ up to nine people in Khyber Pakhtunkhwa. Although Pakistan's minimum wage legislation does not explicitly refer to informal employment, its wording may be interpreted as extending coverage beyond the formal sector. The law does not expressly exclude informal workers or require formal registration or written contracts. In practice, however, minimum wage protections are

[3] Pakistan consists of four provinces—Balochistan, Khyber Pakhtunkhwa, Punjab, Sindh, and the Islamabad Capital Territory.

widely understood to apply primarily to formal employment, and weak enforcement has resulted in widespread non-compliance, particularly in agriculture and small enterprises (International Labour Organization, 2016).

As a result, a substantial share of workers—particularly women and those in agriculture and small enterprises earn below the statutory minimum wage, reflecting weak enforcement rather than gaps in legislation. For example, in 2021, nearly 18(37)% of men(women) earned below the 2002 minimum wage (see Table 1).

For our analysis, we have used the federal minimum wage announced by the federal government. This decision is based on two main reasons. First, there is minimal variation across industries, and detailed information on industry-specific wages is only available for Punjab Province in 2021. In practice, minimum wages for different occupational groups in scheduled industries are not independently set. Instead, they are directly linked to the unskilled workers' wage rate, with annual percentage increases uniformly applied across all groups (International Labour Organization, 2016). Second, we do not observe the provincial minimum wage before 2009, and there is little variation in minimum wage rates across the four provinces[4]. Even though the 18th Constitutional Amendment in 2010 gave provinces the authority to set minimum wages, provincial minimum wages remained closely aligned with the federal unskilled minimum during the period covered by this analysis. Administrative data show that from 2009 to 2017, there was no difference between the federal minimum wage and the minimum wages set by Punjab, Sindh, Balochistan, and Khyber Pakhtunkhwa. Wage adjustments occurred simultaneously across all these regions. Only a few minor differences appeared in some years after that, but they did not last or follow a pattern. This strong alignment suggests that the federal minimum wage served as a national wage floor during the period studied. Since provincial minimum wages do not provide additional identifying variation, we rely on the federal minimum wage as the main policy variable, which effectively served as a common reference wage floor across provinces and industries during the period under study.

Accordingly, following Bailey et al. (2021) and Cengiz et al. (2019), our estimates should be interpreted as reduced-form effects of changes in the statutory minimum wage, with bindingness capturing the potential exposure of local labour markets to statutory wage floors under weak enforcement rather than universal compliance. Consistent with this, we observe substantial heterogeneity across districts in the share of workers earning below the minimum wage, which motivates our empirical strategy exploiting pre-policy exposure. This institutional context provides the basis for our empirical strategy, described in Section 3.

[4] The provincial minimum wage data is limited and covers only the period between 2009 and 2021.

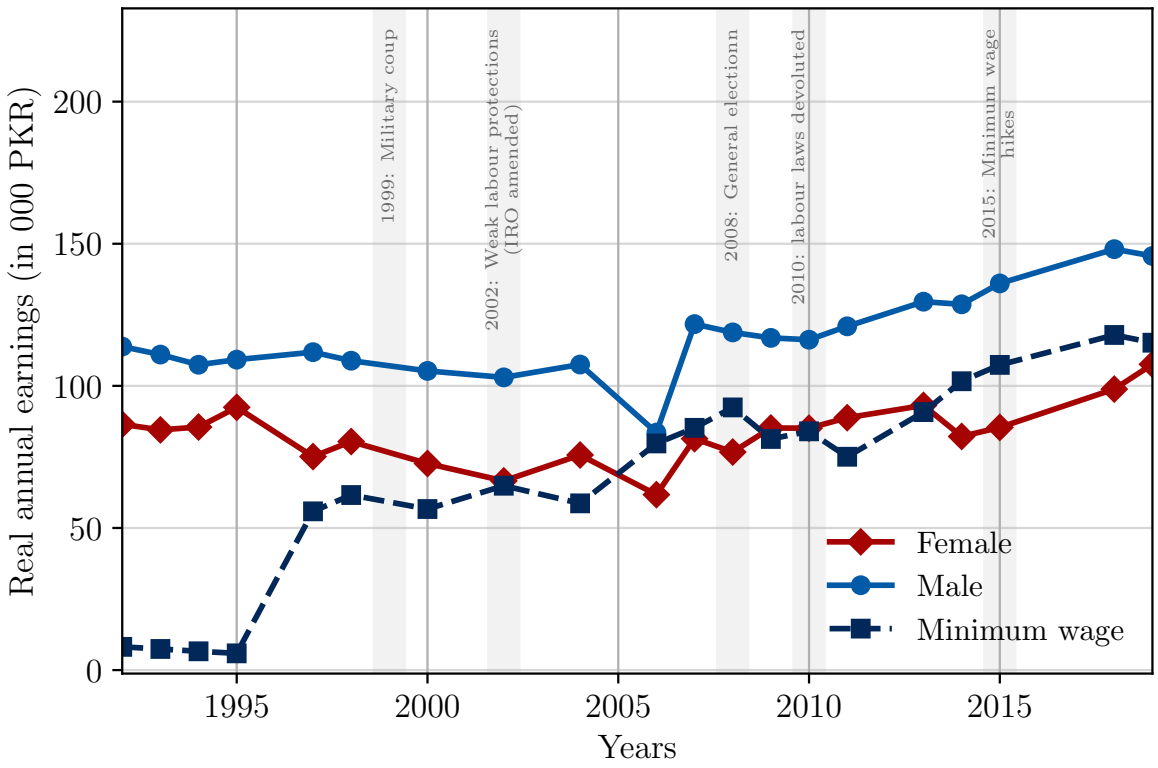


Figure 1: **Yearly real earnings dynamics and real minimum wage**

Notes: We calculate the average real annual earnings for male and female workers based on the LFS data between 1992 and 2019. Specifically, workers are working-age adults, aged 15-64. Each point on the figure corresponds to the average for these categories for each survey wave. Minimum wage is expressed in real and annual terms; see Section 3 for more details.

Wage Dynamics and Minimum Wage. Figure 1 presents the evolution of the federal real annual minimum wage and average real annual earnings for male and female workers from 1992 to 2019. During this period, the minimum wage increased substantially in real terms, though the timing and magnitude of these adjustments varied. After a prolonged stagnation in the early 1990s, when the real annual minimum wage remained approximately 10,000 PKR, a sharp increase in 1997 raised the wage floor to around 60,000 PKR. Subsequent adjustments were more gradual until the mid-2000s, after which minimum wages rose more frequently, reaching about 90,000 PKR by 2008 and increasing further to around 110,000 PKR by 2019.

Average real annual earnings for male workers generally track the upward trajectory of the minimum wage, though they fluctuate over time. In contrast, average earnings for female workers are consistently lower and remain much closer to the statutory minimum throughout the period. During 2006–2009 and 2014–2019, average female earnings appear to fall below the real minimum wage. This pattern likely reflects a combination of weaker enforcement, higher informality, and

differences in labour market attachment among female workers.

Several notable minimum wage adjustments have occurred during periods of macroeconomic volatility, including currency depreciation and elevated inflation. In these periods, average annual earnings for male workers tend to respond to changes in the minimum wage, whereas female earnings remain closer to the statutory minimum. These observed patterns underscore the importance of minimum wage policy in shaping wage dynamics at the lower end of the distribution, particularly for women, and help motivate our analysis in the following sections.

3 Data

In this section, we describe the main data sources and the data preparation procedures. We then outline the composition of the working-age population. In Appendix A, we provide detailed information on variable definition, coverage and data sources. Details on industry and occupation classifications are provided in Table 7.

3.1 Sample and Variables construction.

To assess the effects of the minimum wage policy on wages and hours, we use 21 cross-sectional waves of the official Pakistani Labour Force Survey (LFS) between 1992 and 2021.[5] The LFS surveys provide rich information on income, age, sex, marital status, education, occupation, industry, employment status, enterprise types, and geographical details of each worker. Our cross-sectional LFS surveys are nationally representative, capturing the whole country disaggregated by urban and rural areas. We use the 10-digit processing records to extract each individual's province, division, and district details. The geographical coverage is fairly large, covering 7 provinces, 30 divisions, and 131 districts[6]. The questionnaires for these surveys are almost identical. Since our analysis is explicitly concerned with working-age adults, aged 15-64. We dropped all workers below 15 years old and above 65 years old. We also restrict our sample to paid employees regardless of their employment status and exclude self-employed, as in Bailey et al. (2021). Lastly, we link the LFS data to relevant time series of minimum wage and consumer price index. In what follows, we provide key variables used in our quantitative analysis. Detailed data descriptions and definitions are provided in Appendix A.

Our analysis requires a measure of hourly earnings; the survey provides detailed information

[5] It is worth mentioning that in the Pakistani Labour Force Surveys, we do not observe the same individuals across waves.

[6] Seven administrative provinces are considered in our analysis, which include Khyber Pakhtunkhaw, Punjab, Sindh, Balochistan, Islamabad, Gilgit-Baltistan, and Azad Jammu & Kashmir.

on total earnings from the usual pay. We focus on two questions asked to respondents: i) *How much net money did you earn from the main work last week?* and ii) *How much net money did you earn from the main work last month?* These questions are directed to paid employees regardless of their employment status, including regular paid employees with fixed wages, casual paid employees, paid workers by piece rate or work performed, and paid non-family apprentice.[7] These two questions were included in the questionnaire from the 1990–1991 waves until the latest wave of 2020-2021, whereas early waves (in the 1980s) provided only a single work income information in a categorical format. We compute the Real Hourly Wage$_i$ using the total annual earnings, which are then converted into real values using the annual consumer price index (CPI) and divided by annual hours worked reported in the survey.[8]

Federal minimum wage data are collected from the Pakistan Bureau of Statitics (2026). Minimum wages in Pakistan are primarily determined at the national level, especially before the 2010 devolution.[9] We compute the real hourly minimum wage in year t as follows:

$$\text{MinWage}_t = \text{Monthly Real Minimum Mage}_t / 208.$$

We first convert the monthly nominal minimum wage into real values using the consumer price index, and then divide it by 208 hours. Here, we use a 48-hour weekly schedule ($[48 \text{ hours per week} \times 52 \text{ weeks}]/12 \text{ months} = 208$), to convert the monthly real minimum wage to an hourly basis and align it with our measure of real hourly earnings.[10]

Our empirical approach identifies the effects of minimum wage increases by exploiting national time variation in the statutory minimum wage, interacted with differences across districts in the average share of workers earning below the minimum wage over the sample period. Formally, we measure the level of bindingness across districts by the average share of workers across all years whose real hourly wages fall below the 2002 minimum wage. Using variation in the minimum wage bite is widely used in the empirical literature that evaluates minimum wage effects, especially in contexts where minimum wages do not have clear treatment and control groups. Specifically, we compute the average share of workers in district d with earnings below the 2002 minimum

[7] Note that these two questions are not addressed to the self-employed, and therefore, this category of workers is not covered in our sample. For example, if a respondent is self-employed, they were asked a different question: *How much net money did you earn during last year from own business/ agriculture farm?*

[8] Observations with missing information on annual earnings or hours worked are excluded from the analysis.

[9] Consistent province-level minimum wage data are available for only a limited subset of provinces and years. Therefore, this analysis focuses on the federal minimum wage, which is applicable nationwide.

[10] The use of a 208-hour monthly schedule is motivated by the official Federal legislation ("The Factories Act 1934", Government of Pakistan (1934)), which limits the weekly working schedule to 48 hours.

wage $MinWage^{2002}$ across all survey years:

$$\text{Exposure}_d^{2002} = \frac{1}{T}\sum_{t=1}^{T}\frac{1}{N_{d,t}}\sum_{i\in d,t}\mathbb{1}(\text{Real Hourly Wage}_{i,d,t} < MinWage^{2002}).$$

We use the minimum wage level of 2002. As shown in Figure 1, Pakistan experienced multiple political and economic crises between 1992 and 2019, several of which coincided with substantial minimum wage increases. The year 2002 stands out as the year when the Industrial Relations Ordinance (IRO) was amended under military rule, thereby resulting in weaker labour protection.[11]

We construct a measure of informality based on the LFS definitions, which rely primarily on enterprise type and size. Typically, employment in the informal sector could be identified by the respondent being in a household enterprise owned and operated by own-account workers. For paid employees, we verify the nature of the enterprise where they work, in particular, whether the establishment keeps written accounts and the size of the establishment. These criteria which fit with the broader definition of informality allow us to identify workers who are more likely to be engaged in unregulated jobs.

Last but not least, to perform an additional robustness check, we build a new district-year panel by aggregating individual-level observations to annual averages within each district. Using this panel, we examine the effects of minimum wage policy on earnings at the district level.

3.2 Composition of working age population.

Table 1 presents the characteristics of employed workers in Pakistan in 1992 and 2021, disaggregated by gender. Women consistently constitute a small proportion of the employed workforce. In 1992, female workers averaged about 41 hours per week, compared to approximately 49 hours for male workers, and this gap persists in 2021. Real hourly wages also differ by gender, with the average log real hourly wage for male workers exceeding that of female workers in both periods. The wage gap narrows only modestly over time.

Educational attainment varies significantly by gender and over time. In 1992, the proportions of male and female workers without formal education were similar, at 43 and 44%, respectively. By 2021, educational attainment improved for both groups, yet gender disparities persist. Notably, 33% of employed women held a tertiary degree in 2021, compared to 19% of employed men,

[11] The minimum wage was flat before 1995, increased significantly in 1997 and then trended upward more or less linearly. While 1999 marked the start of the military regime in Pakistan. 2002 represents a clearer structural change in labour market, and thus remains our preferred reference year. However, as an illustration, appendix C.2 includes results with an alternative bindingness measure based on the average share of workers who earn below the 1997 minimum wage.

Table 1: **Descriptive statistics 1992 and 2021**

	1992		2021	
	Male	Female	Male	Female
Number of Observations	5,630	781	58,711	7,817
Total hours per week	48.67	41.17	50.63	39.11
ln **real hourly wage**	3.61	3.47	3.76	3.63
Education (in %)				
No Education	43	44	32	46
Primary education	16	5	20	10
Secondary	20	21	29	11
Tertiary	21	30	19	33
Marital Status (in %)				
Single	28	35	28	24
Married	70	57	71	69
Widow	2	7	1	6
Divorced	0	1	0	1
Part time (in %)	7	21	5	26
Full-time (in %)	93	79	95	74
Below the 2002 Minimum Wage (in %)				
Individual exposure	32	40	18	37
Average district-level share of workers below the MW	34	36	25	29
Informality (in %)	98	98	71	72

Notes: *total hours per week* refers to the mean of hours worked at the main occupation. Education comprises four categories.*No education* refers to the share of workers who never attended school. The remaining categories *Primary education*, *Secondary education*, *Tertiary education* reflect the share of workers with different levels of formal education. Full-time wage workers are those working at least 35 hours. Part-time workers are those reporting less than 35 hours worked. Those who report zero hours worked correspond to the non-participant group.

suggesting positive selection of women into employment. The distribution of marital status is broadly similar across genders in both years. However, employment arrangements differ substantially: in 2021, 95% of male workers were employed full time, whereas 26% of female workers were employed part time.

A striking pattern emerges over time. In 1992, 32% of male workers earned less than the 2002 minimum wage; by 2021, this share had declined sharply to 18%. Over the same period, the corresponding share among female workers changed little. This suggests that wage growth disproportionately lifted male workers out of low-paid employment. A similar pattern is observed at the district level.

Another notable feature of the labour market is the large share of workers employed in the informal sector, where women are disproportionately represented. Widespread informality creates further barriers for women to integrate into the labour force and may help explain their persistently lower rates of labour force participation relative to men. This pattern is consistent with the broader characterisation of the Pakistani labour market as one marked by low female labour force participation, extensive informal employment, and weak enforcement of labour regulations.

4 Results

In this section, we present estimates of the effects of minimum wage on hourly wages using individual-level data. We examine the channels through which minimum wage increases affect earnings, assessing whether these effects operate through adjustments in hours worked, are concentrated among workers with specific characteristics, or vary across the wage distribution.

4.1 Impacts at individual level

Labour markets in Pakistan exhibit significant gender inequality in both earnings and working conditions. Minimum wage policy is frequently identified as a potential mechanism for mitigating these disparities. We examine whether changes in the statutory minimum wage are associated with differential adjustments in individual earnings across districts with varying exposure to the policy.

Our empirical approach leverages cross-district variations in the bindingness of the minimum wage. In particular, we follow the routes taken by current empirical studies such as Bailey et al. (2021) and Cengiz et al. (2019), among many others. Changes in the statutory minimum wage result in heterogeneous exposure across districts, as the policy could exert a stronger effect in lower-wage local labour markets. We exploit this differential exposure by comparing wage dynamics over time between districts where the minimum wage is more binding and those where it is less binding, treating the district as the relevant local labour market. The following equation constitutes our benchmark:

$$\ln y_{i,d,t} = \beta_0 + \beta_1 \left[\ln MinWage_t \times \text{Exposure}_d^{2002}\right] + \alpha_d + \alpha_t + \gamma \mathbf{X}_{i,d,t} + \epsilon_{i,d,t} \tag{4.1}$$

where i indexes individuals of working age (15-64), d indexes districts, and t indexes the survey year. $\ln y_{i,d,t}$ denotes the log real hourly earnings. The coefficient β_0 is the constant, and $\ln MinWage_t$ denotes the log of the real hourly minimum wage, and Exposure_d^{2002} is the level of bindingness across districts. Because the minimum wage varies only over time at the national level, our identification comes from the interaction of time variation in the minimum wage with the average share of workers earning below the 2002 minimum wage across districts and over the sample period. The coefficient β_1 is the parameter of interest, capturing the association between minimum wage changes and worker real hourly wages across districts, with different levels of exposure. α_t denotes year fixed effects that absorb common macroeconomic shocks, and α_d denotes district fixed effects that control for time-invariant characteristics of local labour markets. $\mathbf{X}_{i,t}$ is a vector of control variables and $\epsilon_{i,t}$ is the error term. Standard errors are clustered at the

district level.[12]

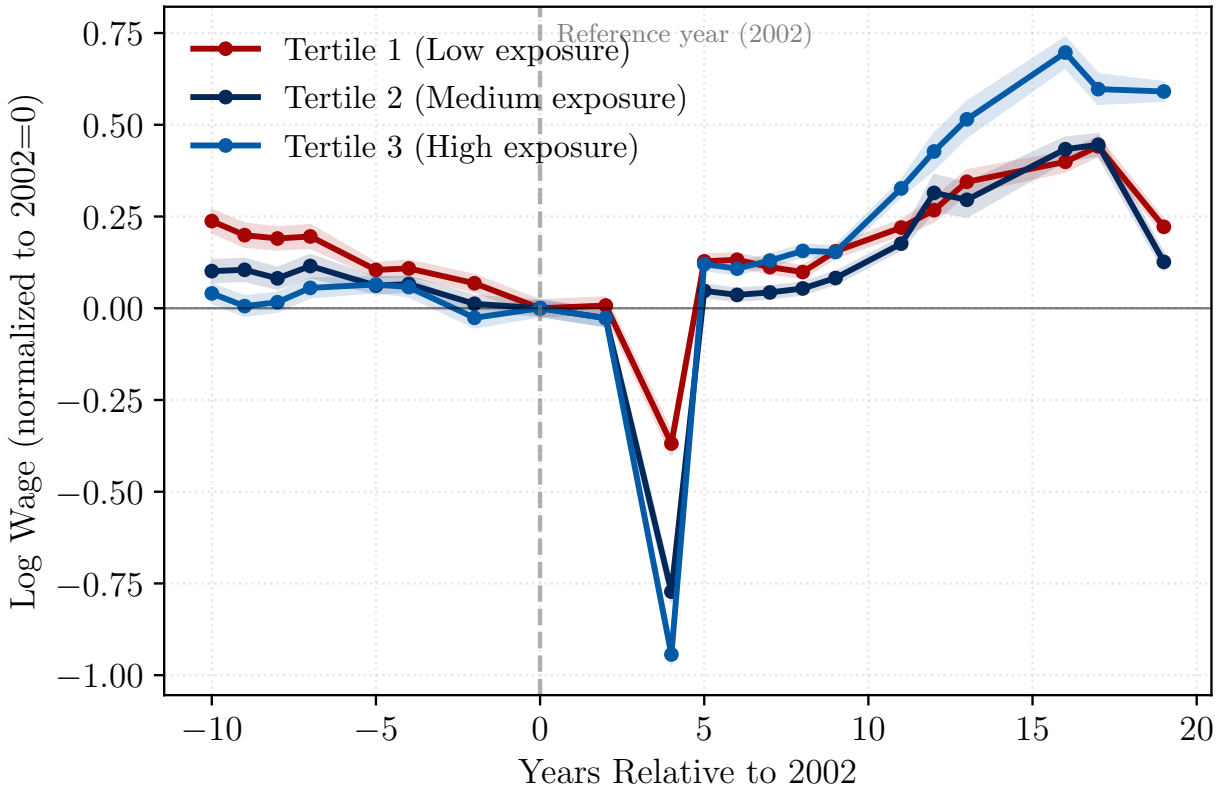


Figure 2: **Wage trends relative to 2002 by exposure group**

Notes: This figure shows the mean ln hourly wage normalised to zero in 2002, for districts with high, medium and low pre-2002 exposure to minimum wage, and their corresponding 95% confidence intervals.

One may argue that districts with high and low exposure may be on different paths prior to the 2002 minimum wage policy change. To assess if the parallel trends assumption holds, in figure 2, we plot the average ln hourly wage across three exposure groups (districts with high, medium and low exposure). Zooming on the pre-2002 period, we observe that pre-treatment hourly wage trends are reasonably parallel across all three groups. In the appendix, we present additional statistical tests to confirm this. Column (1) of Table 11 in the appendix shows that two of the three district groups show no differential trends, suggesting borderline but still supportive evidence of parallel trends in the pre-treatment (joint F test: p =0.097). Column (2) of Table 11 in the appendix

[12] We cluster our standard errors at the district level to account for within-district correlation in residuals. Clustering standard errors at this level is justified because the interaction $\ln(\text{MinWage}_t) \times \text{Exposure}_d^{2002}$ creates variation at the district level. Clustering standard errors at the year level will not be the best option since we have only 21 survey waves, which is relatively few. Additionally, using heteroskedasticity robust standard errors could underestimate standard errors and results into false statistical significance when there is within-district correlation in residuals.

shows no evidence of differential trends across exposure groups (p=0.25), which further supports our identification assumption.

Table 2: **Effects of minimum wage policy on real hourly wages**

	Dependent variable: ln *hourly wage*		
	Full sample	Male only	Female only
	(1)	(2)	(3)
constant	3.296***	3.322***	3.151***
	(0.130)	(0.129)	(0.187)
$\ln MinWage \times Exposure_d^{2002}$	0.294**	0.305**	0.178
	(0.123)	(0.123)	(0.159)
year FE	Y	Y	Y
District FE	Y	Y	Y
Observations	442301	390706	51595
N. of groups	192	192	192
R^2	0.000	0.000	0.000

Notes: This table reports the response of ln hourly earnings to the ln hourly minimum wage $\times$ $Exposure_p^{pre2002}$ for full sample, male only and female only samples. In all specifications, we add both time-fixed effects and district-fixed effects. Standard errors clustered at the district level are reported in parentheses. * Significant at the 10% level. ** Significant at the 5% level. ***. Significant at the 1% level. Sample period:1992-2021

Table 2 presents the estimates of Equation 4.1 for all workers and separately for male and female workers. Column (1) reports estimates for the full sample. The coefficient on the interaction term is positive and statistically significant, indicating that minimum wage increases are associated with larger hourly wage gains in districts where a higher share of workers earned below the statutory minimum prior to the policy period. This finding implies that wage pass-through is concentrated in low-wage local labour markets, where the minimum wage is more likely to be binding. Since the policy variable interacts with exposure, the resulting wage response to a minimum-wage change is proportional to the district's pre-policy exposure. Accordingly, these estimates should be interpreted as reduced-form effects under partial compliance rather than as treatment effects under full enforcement. The estimated magnitudes are modest, consistent with partial compliance and adjustment occurring primarily in low-wage local labour markets.

Column (2) presents results for male workers. We find that minimum wage increases are associated with higher hourly wages for men, with an estimated coefficient that is slightly larger than the full-sample estimate. This suggests that male workers experience stronger wage pass-through from minimum wage increases in more exposed districts. Column (3) reports results for female workers. The estimated coefficient is positive but not statistically significant, suggesting a weaker or more heterogeneous wage response among women. This muted average effect is consistent with greater dispersion in women's labour market attachment and exposure to the

policy, reflecting their higher prevalence in informal, part-time, and lower-compliance employment arrangements, as documented in Section 3.2 and Figure 1.

Table 12 in Appendix C.1 presents several robustness checks. Our main coefficient of the effect of minimum wage remains positive and statistically significant after introducing a range of control variables. In particular, (i) we control for individual characteristics that are strongly correlated with earnings but orthogonal to minimum wage changes, including indicators for low educational attainment, gender, marital status, age, and a non-linear age term. The inclusion of both age and its square captures experience and life-cycle effects on earnings. (ii) we include a measure of extreme heat at the year–province level to account for adverse climatic conditions—such as prolonged droughts and heat stress—that may affect labour productivity and earnings.[13] (iii) We control for five broad industry categories to absorb industry-specific wage determinants.[14] Finally, (iv) we further control for occupations, which allows us to absorb occupation-related wage differentials.[15] We also include dummies for informal sector employment and public sector employment, capturing systematic earnings differences associated with variation in compliance and institutional wage-setting.

Further robustness checks using alternative specifications are provided in Table 13 in the Appendix. In this specification, we exploit cross-district variation in the bindingness of the minimum wage, using 1997 as the reference year rather than 2002. The period from 1992 to 1997 predates the heightened political uncertainty associated with the 1999 military coup and the subsequent amendment of the Industrial Relations Ordinance (IRO) in 2002, and corresponds to a phase in which the IRO remained in force under constitutional rule.

Our main results are consistent with a vast literature that documents a positive impact of minimum wage policy on earnings, though in different contexts. Examples include Grossman (1983), Machin et al. (2003), Berger et al. (2022), Cengiz et al. (2019), Bailey et al. (2021) and Ashenfelter and Jurajda (2022). Though the vast majority of these studies investigated this issue for advanced economies, mostly characterised by regulated labour markets with relatively high compliance, and a minor presence of the informal sector. Our findings extend this literature to a high-informality setting, where partial compliance limits the reach of minimum wage policy.

[13] The extreme heat measure captures the number of days with a heat index exceeding 41 degrees Celsius and is drawn from the World Bank (2024a) Climate Change Knowledge data.
[14] Industry categories are listed in Table 7 in the Appendix.
[15] Occupation categories are listed in Table 7 in the Appendix.

4.2 Additional validation: Impacts at district level

In this section, we pursue an alternative identification strategy to understand the effects of minimum wage policy on real hourly wages at the district level. The baseline model is specified below:

$$\ln Y_{d,t} = \beta_0 + \beta_1 \ln \text{MinWage}_t \times Exposure_d^{2002} + \mathbf{X}_{d,t}\gamma + \alpha_d + \lambda_t + \epsilon_{d,t} \tag{4.2}$$

In the equation, $\ln Y_{d,t}$ represents the logarithm of the average real hourly earnings in district d at time t. The term $\ln \text{MinWage}_{d,t} \times Exposure_d^{2002}$ denotes the log of the real hourly minimum wage interacted with the share of workers earning below the 2002 minimum wage in district d at time t. The vector $\mathbf{X}_{d,t}$ includes control variables that consist of various demographic and economic factors. The parameter α_d accounts for district fixed effects, capturing unobserved time-invariant characteristics specific to each district, while λ_t represents time fixed effects to control for common time trends or shocks across all districts. Finally, $\epsilon_{d,t}$ is the error term, representing the unobserved factors affecting the dependent variable. As before, we cluster our standard errors at the district level.

Table 3: **Panel regression on hourly wage at district level**

	Dependent variable: ln *average hourly pay - district level*					
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	3.895***	3.819***	3.915***	3.896***	3.683***	4.466***
	(0.011)	(0.142)	(0.140)	(0.217)	(0.290)	(0.303)
$\ln MinWage_t \times Exposure_d^{2002}$	0.829***	0.909***	0.827***	0.831***	0.611***	0.410***
	(0.278)	(0.275)	(0.267)	(0.258)	(0.188)	(0.113)
Controls						
Occupation controls	N	N	N	N	N	Y
Industry controls	N	N	N	N	Y	Y
Female labur force share	N	N	Y	Y	Y	Y
Marital status controls	N	Y	Y	Y	Y	Y
Public sector share	N	Y	Y	Y	Y	Y
Share of Low skilled workers	N	Y	Y	Y	Y	Y
Share of informal sector	N	N	N	Y	Y	Y
District FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	1060	823	823	823	823	823
N. of groups	21	19	19	19	19	19
R^2	0.038	0.486	0.506	0.506	0.541	0.592

Notes: Standard errors are clustered at the district level in all regression models. * Significant at the 10 percent level. ** Significant at the 5 percent level. ***. Significant at the 1 percent level.

Table 3 presents the estimates of Equation 4.2. In Columns (1)-(4), we observe that minimum wage hikes consistently induce an increase in real hourly wages, with the effect ranging between 0.83 and 0.91. These estimates indicate that districts with higher pre-policy exposure experience larger increases in average earnings following minimum wage increases. These estimates remain

positive and statistically significant even after controlling for the share of female workers, the share of workers with low educational attainment, the share of married workers, public sector employment, and the share of informal sector employment.

In Column (5), after including industry fixed effects, the estimated minimum wage effect declines but remains positive and statistically significant, suggesting that part of the observed wage response reflects differences in industry composition across districts. Column (6) further incorporates occupation fixed effects, yielding a positive and statistically significant response of hourly wages to minimum wage increases even after absorbing occupation-specific wage premia and detailed workforce composition.

Our district-level results reinforce the individual-level findings and underscore the role of widespread informality in shaping the minimum wage transmission mechanism. While minimum wage increases raise average district-level earnings in more exposed areas, these effects should be interpreted as reflecting partial compliance rather than universal enforcement. In this setting, minimum wage policy operates through a combination of direct wage increases among covered workers and indirect spillovers within local labour markets, while leaving a substantial share of informal and vulnerable workers unaffected.

4.3 Why minimum wage hikes do not induce significant adjustment in earnings?

4.3.1 Heterogeneous effects of minimum wage hikes

In economies like Pakistan, even sizeable increases in the statutory minimum wage may be insufficient to generate large earnings gains. As demonstrated by the results in the previous section, the average effects of minimum wage policy are modest. These limited impacts appear to be driven primarily by weak policy coverage and enforcement, although the effects are highly heterogeneous across workers.

One way to account for the heterogeneous effects of minimum wage policies is to augment the model 4.1 with key indicators and their interaction terms. Specifically, we include a dummy variable I_{female}, which equals one if the individual is female; a dummy variable I_{married}, which equals one if the worker is married; and a dummy variable $I_{\text{low-skill}}$, which equals one if the worker has no formal education or has attained only primary education.

Table 4 shows the results of the model that accounts for differential minimum wage effects. At its core, the interaction term coefficient of $\ln MinWage \times Exposure_d^{2002}$ ranges between $0.2 - 0.3$ across specifications. This indicates that minimum wage increases are associated with higher real hourly earnings in districts where more workers are below the 2002 minimum wage floor. This

pattern confirms that the wage effects of minimum wage policy are concentrated in local labour markets where the statutory floor is more binding. Because the policy variable is interacted with exposure, these estimates reflect differential pass-through across districts with varying degrees of pre-policy bindingness, and should be interpreted as reduced-form responses under partial compliance. In Column (1), our interaction term $\ln MinWage \times Exposure_d^{2002} \times I_{Female}$ allows us to test whether the effect of the minimum wage on wages differs by gender. Our results provide evidence that these effects vary across male and female workers. The interaction coefficient is negative and statistically significant, indicating that female workers experience a smaller wage response to minimum wage increases than men in more-exposed districts. Quantitatively, coefficient for women is substantially smaller than for men. This result suggests that minimum wage policy, on its own, is unlikely to substantially narrow gender wage disparities in Pakistan, particularly in the presence of widespread informality and weaker enforcement.

Our interaction term $\ln MinWage \times Exposure_d^{2002} \times I_{Low.Skill}$ in Column (2) helps us to test whether the effect of minimum wage on wages differs between low-skilled and highly-skilled workers. We find no significant differences in the effects of minimum wage polices between the two groups. This absence of differential pass-through likely reflects offsetting forces: while low-skilled workers are more likely to earn near the minimum wage, they are also more likely to be employed in informal or non-compliant jobs. Note that our estimated coefficients of $I_{Low.Skill}$ are statistically significant, showing that low-skilled workers earn approximately 45% lower hourly wages than their higher-skilled counterparts. Consistent with standard human capital story and empirical evidence, these findings highlight a significant premium for skills in the Pakistani labour market. Column (3) shows the results for married versus unmarried workers and the interaction term $\ln MinWage \times Exposure_d^{2002} \times I_{Married}$ is negative and significant. A 10% increase in the minimum wage is associated with an increase in average real hourly wages of approximately 3.04% for unmarried workers and 2.43% for married workers in districts with higher pre-policy exposure, indicating modestly lower pass-through among married workers.

As shown in Table 4, the minimum wage policy in Pakistan gives rise to earnings differences between workers of different socio-economic categories and potentially shapes labour inequalities. The minimum wage policy is primarily concerned with attenuating wage inequality among workers, but there might be some push and pull factors that could play different roles. Hallward-Driemeier et al. (2017) go in this direction, showing that the impact of minimum wage on gender pay gaps in Indonesia among the least-educated and the best-educated groups differs. We agree with Hallward-Driemeier et al. (2017) that reducing or increasing this gap relies on workers' skill and education level. Other studies such as DiNardo et al. (1996), Bargain et al. (2019), and Chen

Table 4: **Heterogeneous effects of minimum wage policy on real hourly wages**

	Dependent variable: ln *hourly wage*		
	(1)	(2)	(3)
constant	1.867***	2.445***	1.900***
	(0.115)	(0.093)	(0.120)
$\ln MinWage \times Exposure_d^{2002}$	0.305***	0.203**	0.304***
	(0.107)	(0.093)	(0.114)
I_{Female}	0.081**		
	(0.033)		
$\ln MinWage \times Exposure_d^{2002} \times I_{Female}$	-0.255***		
	(0.026)		
$I_{Low.Skill}$		-0.448***	
		(0.025)	
$\ln MinWage \times Exposure_d^{2002} \times I_{Low.Skill}$		-0.024	
		(0.020)	
$I_{Married}$			0.104***
			(0.028)
$\ln MinWage \times Exposure_d^{2002} \times I_{Married}$			-0.061**
			(0.026)
Controls	Y	Y	Y
year FE	Y	Y	Y
District FE	Y	Y	Y
Observations	442301	442301	442301
N. of groups	192	192	192
R^2	0.109	0.196	0.098

Notes: This table reports the response of log real hourly earnings to the minimum wage under different model specifications. $I_{Married}$ is an indicator variable equal to 1 if the worker is married, $_{Low.Skill}$ is an indicator variable equal to 1 if the individual never attended school or attained primary education. I_{Female} is an indicator variable equal to 1 if the worker is a woman. In all estimations, we add age and age-squared controls; we also control for both time-fixed effects and district-fixed effects. Standard errors are clustered at the distrcit level and reported in parentheses. * Significant at the 10 percent level. ** Significant at the 5 percent level. ***. Significant at the 1 percent level. Sample:1992-2021

and Xu (2025), highlighted the potential of minimum wage policies to narrow the gender wage gap and the role of the level of compliance in determining the effectiveness of this policy.

4.3.2 Hours worked

We now turn to the relationship between the number of hours worked and the minimum wage. Empirical evidence suggests that minimum wage hikes affect hours worked and could offset the impact of minimum wage. Following a policy change, firms may adjust usual working hours in order to contain labour costs, rather than—or in addition to—adjusting employment levels. This adjustment along the intensive margin constitutes an important channel through which minimum wage policy may dampen its overall impact on earnings.

Estimates of this relationship are displayed in Figure 3, where the dependent variable is the log of total annual hours worked, and all specifications account for a full set of controls. In panels

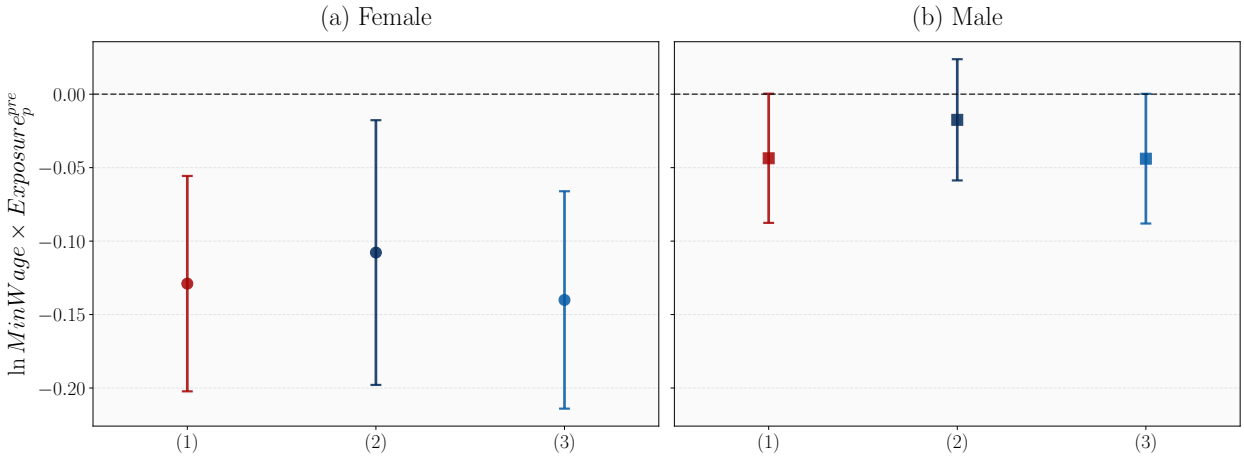


Figure 3: **Minimum wage policy and hours worked**

This figure reports the coefficients of minimum wage under different model specifications with confidence intervals and clustered standard errors at the district level. In all specifications, we account for a full set of controls. For a description of the variables and detailed results see Tables 15 and 14 in Appendix C.3.

(a) and (b), we report the estimates of the model separately for female and male workers.

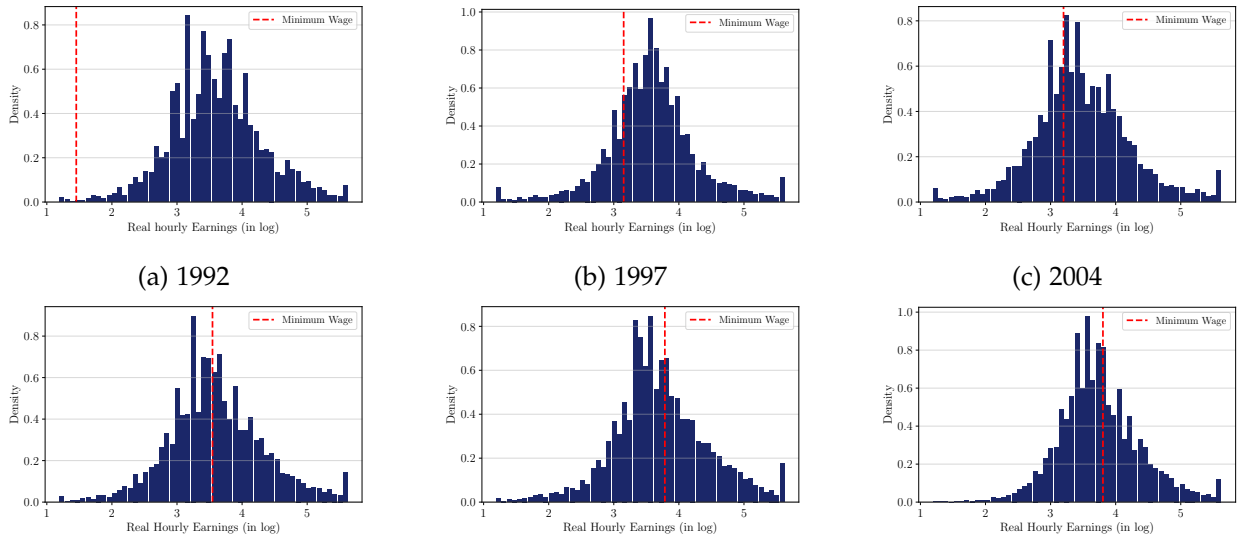
In panel (a), we observe that female workers are more responsive to minimum wage hikes. Female workers experience a significant reduction in hours worked across all specifications (see Table 14 in Appendix C.3), with coefficients ranging from approximately −0.11 to −0.14, all of which remain statistically significant. These findings indicate that a 10% increase in the minimum wage is associated with a reduction in hours worked of about 1.1–1.4% for women in more exposed districts. Although statistically significant, these effects are economically modest, suggesting that adjustment in hours is not the primary channel of response to minimum wage increases. The response of hours worked among women aligns with their higher representation in part-time, informal, and flexible employment arrangements, where employers can more readily adjust hours rather than wages.

Analysis of the male-only subsample, as presented in panel (b), indicates that the negative association between minimum wage increases and hours worked is weaker and less robust among men. Although baseline specifications suggest a modest decline in hours worked, the coefficient loses statistical significance when additional controls are applied (see Table 15 in Appendix C.3). This outcome suggests that hours adjustment among male workers is limited and unstable. While there is some evidence that low-skilled men may experience greater reductions in hours, these effects are not consistently estimated across specifications, which restricts the strength of conclusions for this subgroup.

Overall, these results indicate modest and varied reductions in hours worked following increases in minimum wages, with more substantial and consistent effects observed among women. Collectively, these findings imply that adjustments in labour supply along the intensive margin are less significant than wage adjustments, especially in labour markets marked by partial compliance, extensive informality, and flexible employment arrangements.

The negative relationship between minimum wage policies and hours worked has been previously documented by Sabia (2009), Jardim et al. (2022), and Bossler et al. (2026). Gindling and Terrell (2007), show that a 10% increase in minimum wages in Costa Rica leads to a fall in hours worked by approximately 0.6% in the covered sector and decreases employment by 1.09% of covered sector employees. They find that the minimum wage policy does not have a significant effect on hours worked in the uncovered sector. Although our estimates are much smaller in magnitude, suggesting that hours adjustment to the minimum wage hikes is apparently not the prime channel through which these policies affect the labour supply.[16]

4.3.3 Distributional impact of minimum wage policy.



(a) 1992 (b) 1997 (c) 2004

(d) 2010 (e) 2015 (f) 2021

Figure 4: **Minimum wage and income distribution**

Notes: This figure displays the real hourly minimum wage (in log) and the kernel density of real hourly earnings (in log) for the years: 1992, 1997, 2004, 2010, 2015 and 2021.

How far is the minimum wage floor from the real wages of high- and low-income earners? To answer this question, Figure 4 plots the distribution of real hourly earnings for selected years and

[16] For a recent review of the employment effects literature, see Neumark and Shirley (2022).

the corresponding minimum wage in that year. In 1992 and 1997 (Panels a and b), the minimum wage lies well to the left of the earnings distribution, affecting only a small segment of low-income workers. However, from 2004 onwards (Panels c to f), the minimum wage shifts noticeably closer to the median of the distribution, with a substantial portion of the population—particularly low-skilled and low-wage earners—clustered around or below the statutory wage floor. The observed visual pattern shows a significant increase in the policy's effective coverage over time. This change suggests that the minimum wage became increasingly binding over time and thus more effective as a wage-setting instrument. Importantly, increased bindingness reflects the interaction of rising statutory wage floors with slow growth in real earnings, rather than uniform improvements in compliance. The post-1997 period, therefore, marks a regime shift in the reach and relevance of the policy, with the minimum wage covering a much larger share of the labour force. While minimum wage adjustments may respond to macroeconomic conditions, they are set at the national level and do not directly condition on district-level wage distributions, mitigating concerns that the observed changes in bindingness are driven by endogenous policy timing. These shifts occurred alongside broader economic and institutional changes: Pakistan initiated market-oriented reforms under an IMF-supported adjustment program in 1988, with trade liberalisation accelerating following WTO accession in 1995 (Khan et al., 2021). The post-2002 period also saw a weakening of labour unions, reducing collective bargaining power, while the expansion of low-wage, labour-intensive industries and recurring inflation episodes further eroded real incomes, particularly among low-skilled workers. Moreover, persistent political instability—including frequent government turnover and the 1999 military coup—contributed to policy uncertainty and weakened institutional support for wage regulation and labour protections.

While the minimum wage appears binding for a large share of workers after 2004, as indicated by its position near the median of the earnings distribution, the persistent mass of workers earning below the statutory threshold points to substantial and persistent enforcement failures. This coexistence of formal wage-setting power and widespread non-compliance underscores the dual nature of Pakistan's labour market. In this context, minimum wage legislation is partially effective in raising wages for covered workers, but remains ineffective in protecting many workers in informal, low-wage, and otherwise vulnerable segments of the workforce.[17]

Table 5 reports the point estimates for the impact of the minimum wage on real hourly earnings across the wage distribution. Here we divide the sample into five income groups: low income (0-20 percentile), low-middle income (20-40 percentile), middle income (40-60 percentile), middle-

[17] Table 17 shows how minimum wage hikes are associated with a decrease in informality, particularly among high-wage workers.

Table 5: **Hourly wage response to minimum wage policy across the wage distribution**

	Dependent variable: hourly wage				
	0-20 (low income)	20-40 (low-middle income)	40-60 (middle income)	60-80 (middle-high income)	80-100 (high income)
	(1)	(2)	(3)	(4)	(5)
constant	2.414***	3.196***	3.533***	3.829***	4.712***
	(0.052)	(0.011)	(0.010)	(0.013)	(0.043)
$\ln MinWage \times Exposure_d^{2002}$	0.038	0.011	-0.002	0.030***	-0.040
	(0.040)	(0.009)	(0.009)	(0.011)	(0.037)
Controls	Y	Y	Y	Y	Y
year FE	Y	Y	Y	Y	Y
District FE	Y	Y	Y	Y	Y
Observations	89711	90062	86488	87934	88106
N. of groups	192	192	192	192	192
R^2	0.014	0.005	0.008	0.030	0.053

Notes: This table reports the response of the hourly wage to the minimum wage along the wage distribution. All specifications account for year fixed effects and district fixed effects. *Controls* include age and age squared, female dummy, marriage dummy and low educational attainment dummy. Standard errors clustered at the district level are reported in parentheses. * Significant at the 10 percent level. ** Significant at the 5 percent level. ***. Significant at the 1 percent level. Sample:1992-2021

high income (60-80 percentile), and high income (80-100 percentile).The estimated coefficient for low-pay workers (percentile group 0–20) is positive and imprecisely estimated, indicating that minimum wage increases do not translate into meaningful wage gains for workers most directly exposed to the statutory floor. Estimates for the 20–40 and 40–60 percentile groups are close to zero and not statistically significant. The point estimate becomes positive and statistically significant when we look at the upper-middle segment of the wage distribution (60–80 percentile). This pattern likely reflects indirect wage spillovers or compositional effects rather than direct exposure to the minimum wage. By contrast, the estimated effect for the top income group (80–100 percentile) is negative and statistically insignificant, indicating no robust wage response among high-income workers.

This pattern contrast with the view that low-pay earners benefit more from minimum wage policies, as echoed in Ashenfelter and Jurajda (2022), Machin et al. (2003) and Grossman (1983), and many other studies.[18]. Indeed, low-pay workers tend to be close to the minimum wage floor and are naturally more affected by this policy. The absence of statistically significant effects for most of the lower and upper tails underscores that the minimum wage policy in Pakistan does not generate uniform wage growth across the distribution. These distributional patterns are consistent with a broader literature documenting wage gains from minimum wage reforms, while also highlighting the limits of their incidence in high-informality settings (Wong, 2019; Caliendo and

[18] Bossler and Schank (2023) document that the minimum wage led to significant increases in monthly wages among the existing workforce e.g., by 12% at the 5th percentile, by 21% at the 20th percentile, and by 2% at the 50th percentile of the unconditional wage distribution.

Wittbrodt, 2022; Pérez, 2020; Saltiel and Urzúa, 2022). In our context, estimates of distributional effects are sensitive to specification, reflecting substantial heterogeneity in exposure to the policy and in compliance across workers.

A final consideration is that many of the adjustments in hourly earnings after minimum wage hikes operate through other channels, other than labour regulation compliance. Columns 1 and 2 of Table 18 in the Appendix provide alternative possible explanations; it shows that increases in minimum wage slightly reduce the probability of working in informal jobs among more affected workers, while increasing the probability of working in part-time jobs for the same category. Sectoral employment reallocation is also a relevant channel. Columns 3-7 in Table 18 suggest that minimum wage hikes are associated with an increase in the probability of employment in manufacturing, services, and agriculture, but we see the reverse sign for sectors such as construction and mining. Overall, these findings underscore the importance of recognising structural barriers in developing economies when assessing the effectiveness of minimum wage policies. Sectoral segregation, the prevalence of informal employment, and persistent gender norms all limit the capacity of wage floor regulations to promote gender equity.

5 Conclusion

This study provides a comprehensive analysis of how minimum wage policies influence labour market dynamics in a high-informality developing country context. Using a unique long panel compiled over two decades of labour force surveys in Pakistan. We estimated the effects of continued increases in the minimum wage on wages and hours worked across districts with different levels of pre-policy exposure. Our findings offer critical insights into the effectiveness of minimum wage adjustments in shaping earnings and employment outcomes.

Several key conclusions emerge from our analysis. First, minimum wages have the potential to reduce wage inequality in middle-income countries such as Pakistan. However, their effectiveness is often constrained by widespread non-compliance and the dominance of informal labour markets. Compliance with minimum wage regulations remains a critical determinant of the policy's success in reducing wage disparities (Bargain et al., 2019). Second, our findings highlight the heterogeneous effects of minimum wage policies across demographic groups. While minimum wage increases are associated with modest overall wage growth, their distributional impacts vary considerably. Female workers experience relatively lower wage gains, suggesting that minimum wage policies on their own cannot narrow gender wage gaps. Our results contrast with prior evidence from high-income countries, where minimum wage hikes tend to reduce gender pay

disparities. In some cases, male workers benefit more from wage increases than female workers. However, skill-based differences in wage effects are modest and not robust across specifications. At the district level, our estimates show that significant wage gains at local labour markets occur when minimum wage increases, supporting the policy's role in improving local labour market performance.

Policy implications follow directly. Minimum wage legislation should be complemented by targeted interventions that strengthen enforcement, promote gender-sensitive employment protections, and address occupational segregation. Such reforms are necessary for fostering more equitable labour market outcomes and for ensuring that statutory wage floors translate into inclusive and gender-equitable gains. Future research should examine the long-term impacts of minimum wage reforms, particularly their interaction with broader labour institutions and policy environments, to provide further insights into their potential for promoting inclusive and sustainable economic growth.

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Appendix: Minimum Wage and Labour Market Dynamics in Pakistan

Aicha Kharazi & Saite Lu & Ghulam Mustafa

Contents

Appendix A Data Appendix

A.1 Data Sources

All the data collected covers the period between 1992 and 2021.

Data	Source	Frequency
Labour Force Survey	Federal Government	Survey waves-annual
Climate Change Knowledge Data	World Bank (2024a)	Annual and province level
Consumer Price Index	Federal Government	Annual and national level
Federal Minium Wage	Federal Government	Annual and national level

Table 6: **Data Sources**

A.2 Data Harmonisation: industries and occupations

We create eight occupation categories, which are described in panel (a) of Table 7, and five industry groups, which are illustrated in Panel (b) of Table 7

Table 7: **Harmonization**

Category	**Code**	**Description**
Panel a: Occupation categories		
1	1111–1439 and 2111–2659	Professionals.
2	3111–3522	Technicians and Associate Professionals
3	4110–4419	Administrative
4	5111–5419	Services and Sales
5	6111–6340	Agriculture
6	7111–7549	Skilled Craft and Trades
7	8111–8350	Production
8	9111–9629	Elementary
Panel b: Industry categories		
1	111–322	Agriculture, forestry, and fishing.
2	1010–3320	Manufacturing.
3	4100–4390	Construction.
4	4510–6820	Services.
5	510–990, 6910–9900, and 3510–3600	Others (including Mining and Quarrying).

Table 8: **Description of key variables**

Variables	**Description**
LFS waves	1991-1992, 1992-1993, 1993-1994, 1994-1995, 1996-1997, 1997-1998, 1999-2000, 2001-2002, 2003- 2004, 2005-2006, 2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2012-2013, 2013-2014, 2014-2015, 2017-2018, 2018-2019, and 2020-2021
Informality	We follow three steps to identify informal workers: (i)) First, we use the employment status question and classify all workers under the categories (2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 14) as informal workers. (2)) In parallel, for those who are in categories 1 and 5, we will apply additional checks: (2.1) For category 1 (regular paid employee), we use the question *"What kind of enterprise?"*. If the enterprise is a household enterprise (individual, partnership, other), is small (less than 10 workers), and has no written accounts. Then, the worker is classified as informal. (2.2) For category 5 (employer), a worker is classified as informal. If the enterprise is small (less than 10 workers) and has no written accounts.
Public sector	We use the question *What kind of enterprise?* to identify public sector workers. This includes workers who selected any of the following categories: *01. Federal Govt. 02. Provincial Govt. 03. Local body Govt. 04. Public enterprise. 05. Public limited company.*
Hours worked	Particularly relevant to our analysis, we also compiled information on the number of hours worked in a week at the main occupation. Respondents were asked the following question: *How many hours did you work each day during the last week at your main occupation?*. They indicate both the number of hours worked during the week and for each day. We computed annual hours worked as follows: Hours worked per year $= h_i \times 52$. Here, we multiply weekly hours worked h_i by 52 weeks.
Num. of Children in Households	We first create the household size variable household_size and set it to the value of 1 for each observation. Then, we create two new variables $\mathcal{N}_5$ which takes the value of 1 if the individual is less than 5 years old and 0 otherwise, and $\mathcal{N}_{12}$ takes the value of 1 if the individual is between 6 and 12 years old. We collapsed the data by the individual identifier and the household serial number for each survey year. Doing so, we ended up with $\mathcal{N}_{12}$ reflecting the number of individuals belonging to the age category 6-12 within a household, $\mathcal{N}_5$ reflecting the number of individuals belonging to the age category 1-5 within a household, and household_size representing the total number of persons in a household. Then, we matched these three new variables with the full sample.
Extreme heat index	corresponds to the number of days with a heat index greater than 41 degrees Celsius at the year and province level. For the estimation, we have linked the individual data with the extreme heat index measure at the year and province level from the World Bank (2024a) "Climate Change Knowledge" data.
Annual Earnings Amount	We focus on the following two questions: *i) How much net money did you earn from the main work last week?* and *ii) How much net money did you earn from the main work last month?* Because respondents reported earnings in different frequencies, we need to harmonise this information by constructing the annual earnings amount measure as follows: $$\text{Annual Earnings Amount}_i = \begin{cases} E_{i,w} \times 52 & \text{if monthly data is missing } E_{i,m} = 0 \\ E_{i,m} \times 12 & \text{if weekly data is missing} E_{i,w} = 0 \end{cases}$$ then we multiply the earnings reported in weekly terms E_w by 52, and earnings reported in monthly terms E_m by 12.
Annual Real Earnings Amount$_i$	$\frac{\text{Annual Earnings Amount}_i}{CPI/100}$
Real Hourly Wage$_i$	$\frac{\text{Annual Real Earnings Amount}_i}{\text{Hours worked per year}}$.
Monthly real minimum wage$_t$	$\frac{\text{Monthly Nominal Minimum Wage} \times 12}{CPI/100} / 12$
MinWage	$\frac{\text{Monthly Real Minimum Mage}}{208}$

A.3 Labour Inequalities: Key Empirical Facts

The labour markets in Pakistan are marked by massive inequality between men and women.

Facts #1: Wage differentials are widened at the bottom end of the wage distribution. Figure 5 presents the difference in log real hourly wage between women and men across the wage distribution. The gap is significant among low-wage workers.

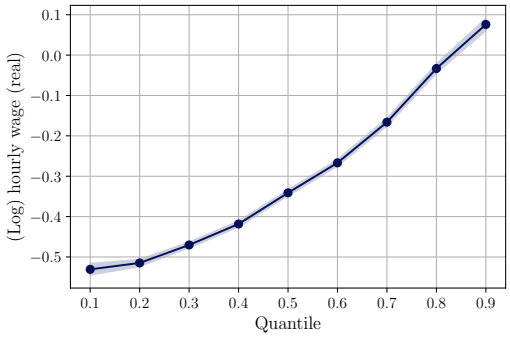


Figure 5: **Gender Wage Gaps Across the Distribution**

Notes: We run a quantile regression at various quantiles, from the 10th to the 90th. The dependent variable of the quantile regression is the log real hourly wage and the regressor is a dummy equal to 1 if the worker is a woman. Estimation period: 1992-2021. The confidence interval is 95% (the shaded area).

Fact #2: Women consistently earn less and work fewer hours than men. Figure 6 presents the real hourly wage distribution for female and male workers.

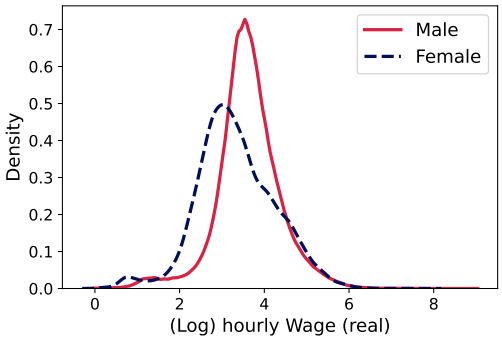


Figure 6: **Differences in real hourly wage distribution by gender**

This figure shows the log real hourly wage distribution for male and female workers

Results in Table 9 reveal that female workers earn less than males, and married workers tend

to earn more than non-married workers. Post-secondary education gives significant advantages to workers, those who have attained higher educational levels earn more than those without a higher degree. In terms of hours worked, female workers work 15% less than male workers, highly educated workers tend to work 1% less than workers without a high-education level, and married workers work 1% less than non-married workers.

Table 9: **Differences in labour market outcomes**

	Dependent variable: log Total hours		
	(1)	(2)	(3)
Constant	7.871***	7.865***	7.878***
	(0.000)	(0.001)	(0.000)
I_{Female}	-0.150***		
	(0.001)		
$I_{Married}$		-0.013***	
		(0.001)	
$I_{T.Edu}$			-0.104***
			(0.001)
Observations	430327	430327	430327
N. of groups	21	21	21
R^2	0.050	0.001	0.047
	Dependent variable: log *hourly wage*		
	(4)	(5)	(6)
Constant	3.615***	3.342***	3.423***
	(0.001)	(0.002)	(0.001)
I_{Female}	-0.286***		
	(0.005)		
$I_{Married}$		0.364***	
		(0.002)	
$I_{T.Edu}$			0.816***
			(0.003)
Observations	430327	430327	430327
N. of groups	21	21	21
R^2	0.011	0.049	0.181

Notes: I_{Female} is an indicator variable equal to 1 if the worker reports being female, $I_{M}arried$ is an indicator variable equal to 1 if the worker is married, $I_{T.Edu}$ is an indicator variable equal to 1 if the worker attained a higher education level. * Significant at the 10 percent level. ** Significant at the 5 percent level. ***. Significant at the 1 percent level. Robust standard errors are reported in parentheses.

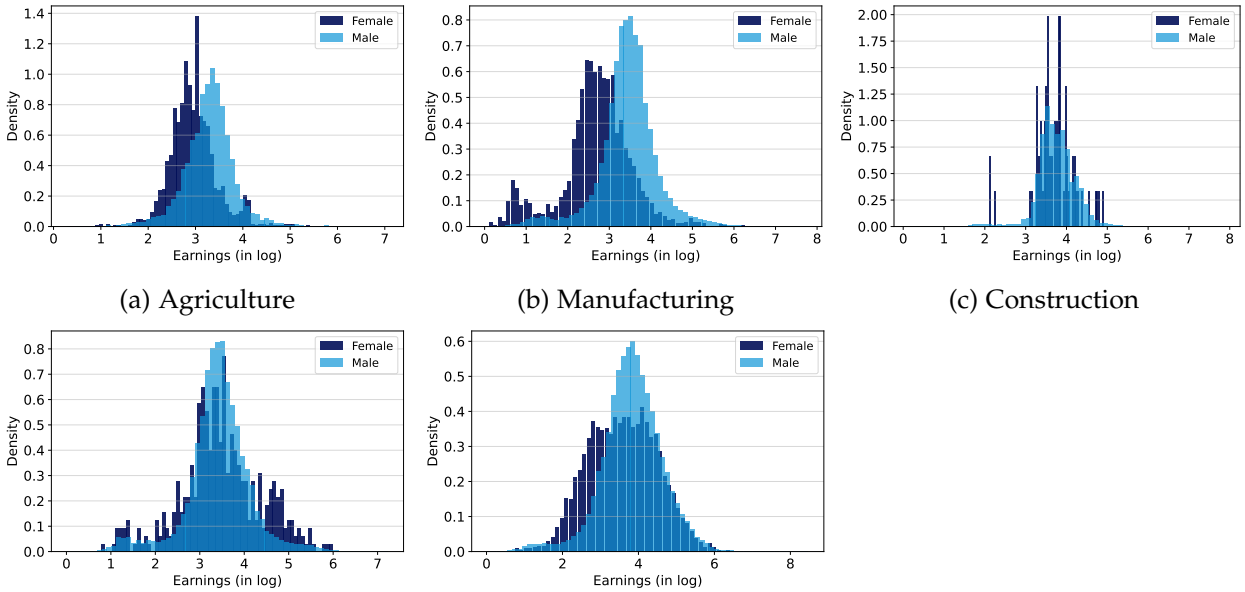
Table 10: **Determinants of the wage differentials between male and female workers**

	Dependent variable: log hourly wage						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	3.615***	3.372***	3.356***	3.413***	3.437***	3.101***	3.107***
	(0.052)	(0.062)	(0.064)	(0.060)	(0.066)	(0.083)	(0.083)
I_{Female}	-0.286***	-0.251***	-0.117***	-0.148***	-0.159***	-0.266***	-0.266***
	(0.025)	(0.021)	(0.017)	(0.017)	(0.019)	(0.014)	(0.014)
$I_{Married}$		0.355***	0.378***	0.363***	0.359***	0.338***	0.342***
		(0.019)	(0.023)	(0.021)	(0.022)	(0.018)	(0.019)
$I_{Female} \times I_{Married}$			-0.224***	-0.221***	-0.220***	-0.083***	-0.083***
			(0.037)	(0.037)	(0.038)	(0.022)	(0.022)
$I_{P.Edu}$				-0.237***	-0.257***	0.093***	0.093***
				(0.015)	(0.013)	(0.012)	(0.012)
$I_{S.Edu}$					-0.059***	0.292***	0.291***
					(0.020)	(0.036)	(0.036)
$I_{T.Edu}$						0.937***	0.935***
						(0.062)	(0.062)
N. of children < 5							-0.042***
							(0.005)
Observations	430327	430327	430327	430327	430327	430327	430312
N. of groups	21	21	21	21	21	21	21
R^2	0.011	0.057	0.059	0.073	0.074	0.260	0.260

Notes: The dependent variable is the real hourly wage. I_{Female} is an indicator variable equal to 1 if the worker is a woman, and $I_{Married}$ is an indicator variable equal to 1 if the worker is married. We control for workers' educational level using: $_{P.Edu}$ is an indicator variable equal to 1 if the individual attained primary education, $_{S.Edu}$ is an indicator variable equal to 1 if the individual attained secondary education, and $_{T.Edu}$ is an indicator variable equal to 1 if the individual attained tertiary education. Variable N. of children < 5 represents the number of children in the age category 1-5 of a given individual. Standard errors in parentheses are clustered at the year level. * Significant at the 10 percent level. ** Significant at the 5 percent level. ***. Significant at the 1 percent level. Sample:1992-2021

Fact #3: The role of education and marital status in explaining wage differentials. Table 10 provides evidence of a significant gender wage gap, even after accounting for marital status and level of education. Women workers do indeed receive significantly lower wages than men workers. For example, as seen in Column (1) of Table 10, female hourly wage is significantly lower by about 25%. An explanation of this could be the differential access to the labour market between men and women, given the lowest participation of women in the labour force. Our results show that married workers earn more, and marriage is associated with higher wages. However, once we control for marital status, we find that women face a significant wage penalty. Specifically, women earn 22% less than men on average, after controlling for marital status. Our findings highlight significant returns to education. Primary education is associated with a 9.3% increase in wages, secondary education with a 29.1% increase, and tertiary education with a substantial 93.5% increase.

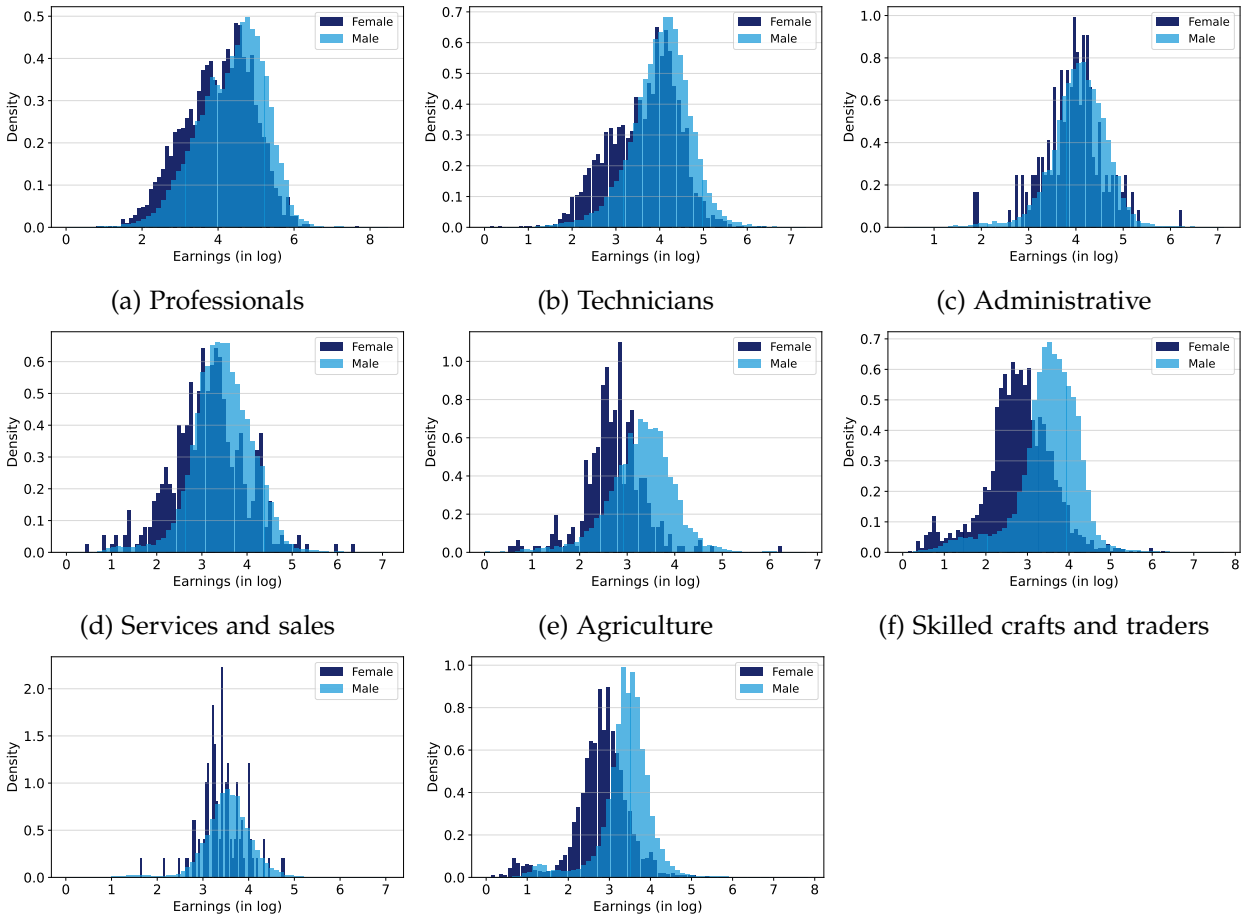
Fact #4: Wage differences across occupation and industries. Exploring wage differences in eight broad occupations and between workers of different genders. The earning distribution of male and female workers differs substantially across occupations. As Figure 8 shows, wages were unequally distributed, in particular for skilled crafts, and traders, and elementary occupations. In contrast, we do not observe such differences in administrative and production occupations.



(a) Agriculture (b) Manufacturing (c) Construction

(d) Services (e) Others

Figure 7: **Earnings distribution by gender and industry**

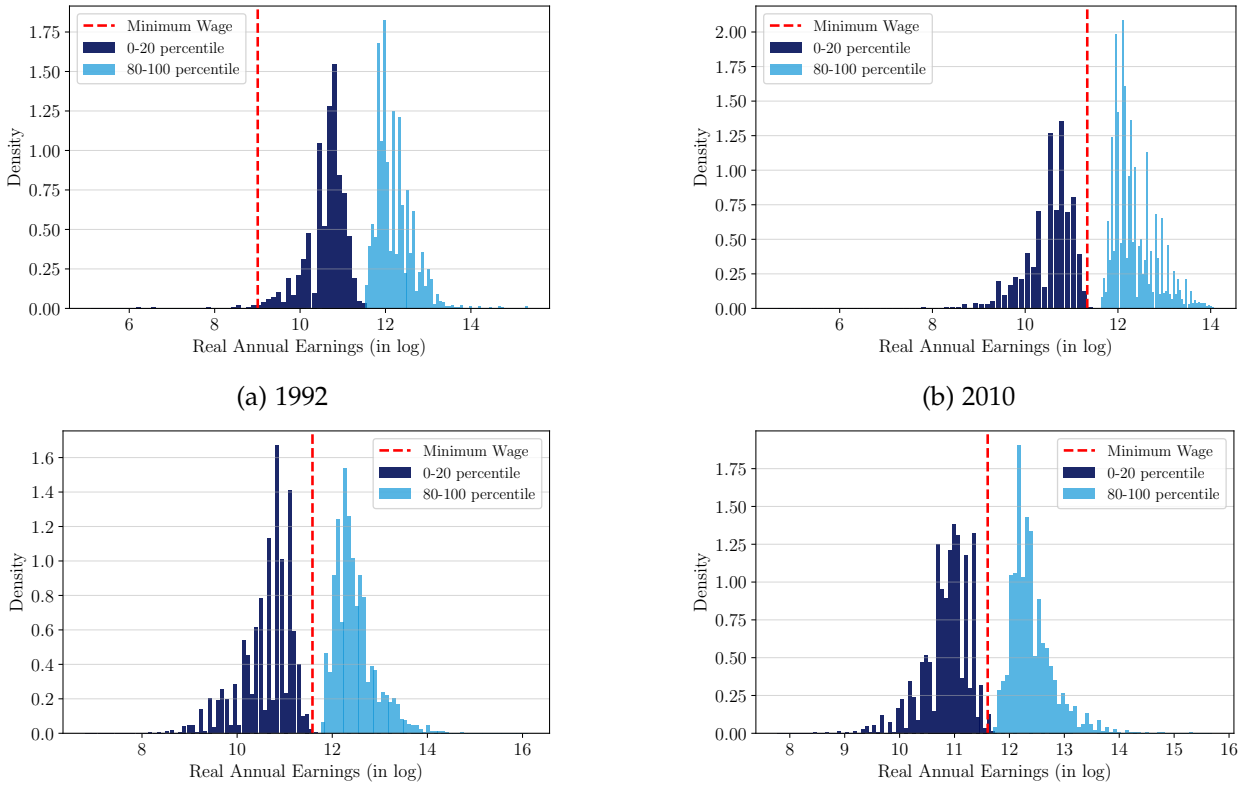


(a) Professionals (b) Technicians (c) Administrative

(d) Services and sales (e) Agriculture (f) Skilled crafts and traders

(g) Production (h) Elementary

Figure 8: **Earnings distribution by gender and occupation**



(a) 1992

(b) 2010

(c) 2015

(d) 2021

Figure 9: **Minimum wage and low versus high income workers**

Notes: This figure displays the real annual minimum wage (in log) and the kernel density of real annual earnings (in log) for the bottom 20% of the income distribution and for the top 20% of the income distribution, for the years: 1992, 2010, 2015 and 2021.

Appendix B Identification: Parallel Pre-Trends Tests

Table 11: **Parallel Pre-Trends Tests**

	Dependent variable: ln *hourly wage*	
	Exposure Groups × Trend	Continuous Exposure × Trend
Constant	3.898***	4.289***
	(0.069)	(0.070)
Low exposure group × Trend	-0.021**	
	(0.010)	
Medium exposure group × Trend	-0.011	
	(0.008)	
High exposure group × Trend	-0.002	
	(0.005)	
Medium exposure group	-0.276***	
	(0.074)	
High exposure group	-0.596***	
	(0.074)	
Average exposure		-2.043***
		(0.212)
Average exposure × Trend		0.041
		(0.036)
Trend		-0.020
		(0.013)
Observations	59394	59394
R^2	0.092	0.095
Adjusted R^2	0.092	0.095
Test for parallel pre-trends:		
Test statistic	F = 2.30	t = 1.15
p-value	0.097	0.251

Notes: Standard errors clustered at the district level are reported in parentheses. * Significant at the 10 percent level. ** Significant at the 5 percent level. *** Significant at the 1 percent level. Sample restricted to pre-treatment years (before 2002). The null hypothesis is no differential pre-trends across exposure groups.

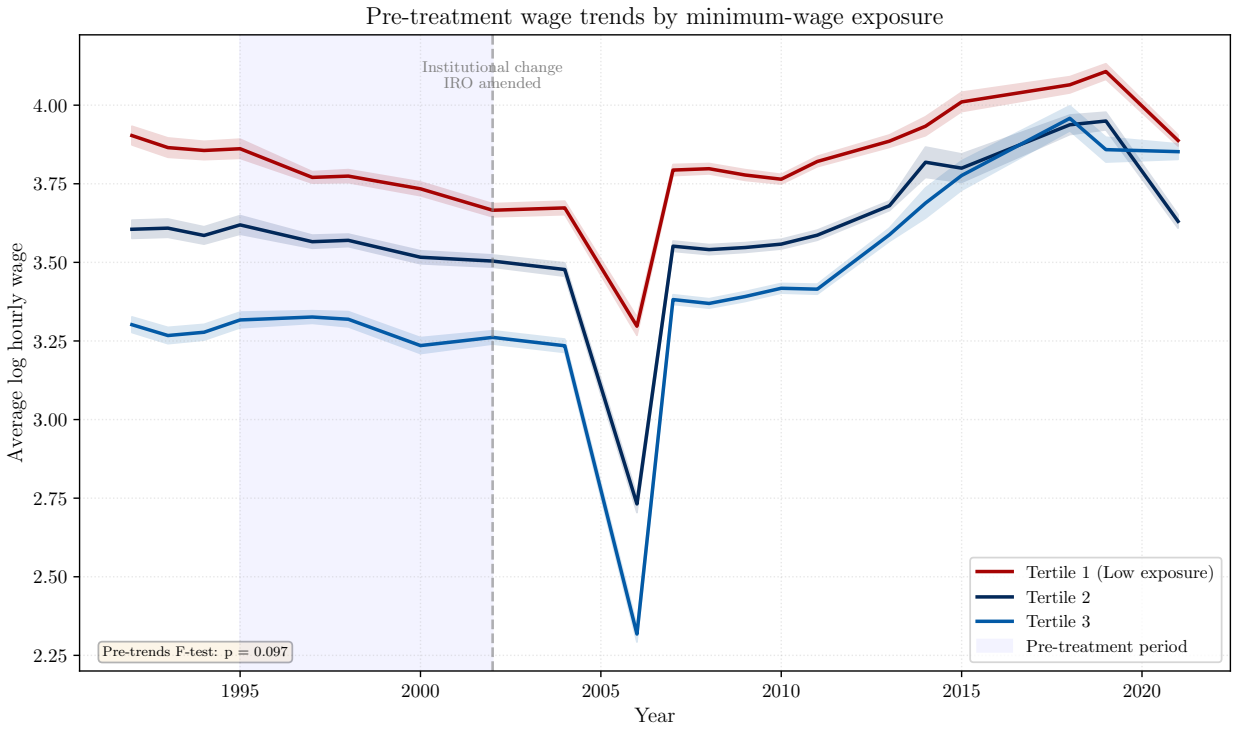


Figure 10: **An illustration of pre-treatment wage trends across three exposure groups**

Appendix C Robustness checks

C.1 Minimum wage and hourly earnings: additional controls

Table 12: **Sensitivity of minimum wage effects to additional controls**

	Dependent variable: hourly wage			
	(1)	(2)	(3)	(4)
constant	2.584***	3.978***	3.637***	3.107***
	(0.092)	(0.442)	(0.112)	(0.096)
$\ln MinWage \times Exposure_d^{2002}$	0.183**	0.321***	0.234**	0.374***
	(0.089)	(0.111)	(0.101)	(0.082)
Controls and FE				
Female dummy	Y	N	N	N
Age	Y	N	N	N
Age squared	Y	N	N	N
Marital status dummy	Y	N	N	N
Low skill dummy	Y	N	N	N
Heat index	N	Y	N	N
Industry controls	N	N	Y	N
Occupation controls	N	N	N	Y
Informal sector	N	N	N	Y
Public sector share	N	N	N	Y
District FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	438283	438283	438283	438283
N. of groups	190	190	190	190
R^2	0.206	0.001	0.097	0.302

Notes: Standard errors clustered at the district level are reported in parentheses. * Significant at the 10 percent level. ** Significant at the 5 percent level. ***. Significant at the 1 percent level. Sample:1992-2021

C.2 Minimum wage effects on hourly earnings using an alternative bindingness measure (reference year 1997).

As previously noted in Figure 1, the 1997 minimum wage increase looks particularly large and was preceded by no substantial variation in the years 1992-1996. Complementing this, Figure 4 in section 4.3.3 illustrates that, prior to 1997, the minimum wage lay well to the left of the earnings distribution, affecting only a small segment of low-income workers. To exploit this substantial change introduced by the regulatory shift in the labour market after 1997, we augment our empirical specification with a bindingness based on the average share of workers who earn below the 1997 minimum wage Exposure_d^{1997}, the estimating equation is thus given by:

$$\ln y_{i,d,t} = \beta_0 + \beta_1 \left[\ln MinWage_t \times \text{Exposure}_d^{1997}\right] + \alpha_d + \alpha_t + \gamma \mathbf{X}_{i,d,t} + \epsilon_{i,d,t} \tag{C.1}$$

In this specification, we control for the same set of covariates as in Equation 4.1. Standard errors are clustered at the district level.

We begin with column (1) of Table 13, where the dependent variable is the log of real hourly wages, and we control for workers' demographic characteristics. The Exposure_d^{1997} interaction term with real minimum wage is positive and significant, with a coefficient of 0.208. This implies that a 10% increase in the real minimum wage in a district with a high share of workers below the 1997 minimum wage led to a 2.08% increase in real hourly wages, indicating that the policy became more binding and effective post-reform. In Column (2), we control for regional variation in extreme heat weather; this is to remove the influence of heat waves on productivity and economic performance. As before, the interaction term appears to be significant, which indicates that wage gains from minimum wage hikes remain significant with a coefficient of 0.359. The specification that accounts for industry-specific factors, see Column (3) of Table **??**, further confirm these findings. The interaction term is statistically significant and positive (0.265), suggesting enhanced effectiveness of the minimum wage in raising real wages in districts with high share of workers below the 1997 minimum wage. Finally, Column (4) shows that once we control for occupations specific characteristic, informal sector and public sector, the impact on hourly earnings increases significantly with a coefficient of 0.424. Note that in all these specifications, we control for year and district fixed effects.

Table 13: **Additional evidence on minimum wage effects on hourly wages using 1997 exposure measure**

	Dependent variable: hourly wage			
	(1)	(2)	(3)	(4)
constant	2.613***	4.016***	3.675***	3.167***
	(0.083)	(0.438)	(0.098)	(0.085)
$\ln MinWage \times Exposure_d^{1997}$	0.208**	0.359***	0.265**	0.424***
	(0.103)	(0.129)	(0.116)	(0.096)
Controls and FE				
Female dummy	Y	N	N	N
Age	Y	N	N	N
Age squared	Y	N	N	N
Marital status dummy	Y	N	N	N
Low skill dummy	Y	N	N	N
Heat index	N	Y	N	N
Industry controls	N	N	Y	N
Occupation controls	N	N	N	Y
Informal sector	N	N	N	Y
Public sector share	N	N	N	Y
District FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	438283	438283	438283	438283
N. of groups	190	190	190	190
R^2	0.206	0.001	0.097	0.302

Notes: Standard errors clustered at the district level are reported in parentheses. * Significant at the 10 percent level. ** Significant at the 5 percent level. ***. Significant at the 1 percent level. Sample:1992-2021

C.3 Hours worked responses to minimum wage increases by gender

Table 14: **Female only sample: Minimum wage and hours worked**

	Dependent variable: hours worked		
	(1)	(2)	(3)
constant	7.788***	7.756***	7.814***
	(0.046)	(0.054)	(0.046)
$\ln MinWage \times Exposure_d^{2002}$	-0.129***	-0.108**	-0.140***
	(0.037)	(0.046)	(0.038)
$I_{Low.Skill}$		0.057***	
		(0.019)	
$\ln MinWage \times Exposure_d^{2002} \times I_{Low.Skill}$		0.004	
		(0.015)	
$I_{Married}$			-0.041***
			(0.010)
$\ln MinWage \times Exposure_d^{2002} \times I_{Married}$			0.014*
			(0.008)
Controls	Y	Y	Y
Observations	51595	51595	51595
N. of groups	192	192	192
R^2	0.027	0.031	0.028

Notes: This table reports the responses of the ln hours worked to the $\ln MinWage \times Exposure_d^{2002}$ for female only sample. *Controls* include five industry dummies, an informal sector dummy, and a public sector dummy. We also include time-fixed effects and district-fixed effects. Standard errors clustered at the district level are reported in parentheses. * Significant at the 10 percent level. ** Significant at the 5 percent level. ***. Significant at the 1 percent level. Sample:1992-2021

Table 15: **Male only sample: Minimum wage and hours worked**

	Dependent variable: hours worked		
	(1)	(2)	(3)
constant	7.888***	7.855***	7.884***
	(0.023)	(0.022)	(0.024)
$\ln MinWage \times Exposure_d^{2002}$	-0.044*	-0.017	-0.044*
	(0.022)	(0.021)	(0.023)
$I_{Low.Skill}$		0.054***	
		(0.006)	
$\ln MinWage \times Exposure_d^{2002} \times I_{Low.Skill}$		-0.025***	
		(0.005)	
$I_{Married}$			0.006
			(0.004)
$\ln MinWage \times Exposure_d^{2002} \times I_{Married}$			-0.000
			(0.004)
Controls	Y	Y	Y
Year FE	Y	Y	Y
District FE	Y	Y	Y
Observations	390706	390706	390706
N. of groups	192	192	192
R^2	0.068	0.071	0.068

Notes: This table reports the responses of the ln hours worked to the $\ln MinWage \times Exposure_d^{2002}$ for male only sample. *Controls* include five industry dummies, an informal sector dummy, and a public sector dummy. We also include time-fixed effects and district-fixed effects. Standard errors clustered at the district level are reported in parentheses. * Significant at the 10 percent level. ** Significant at the 5 percent level. ***. Significant at the 1 percent level. Sample:1992-2021

C.4 Minimum wage and lower tail of wage distribution (Kaitz index: minimum to median)

We follow the identification strategy of Autor et al. (2016), who estimated the effect of effective minimum wage on wage inequality using an instrumental variable approach. The first stage

$$\begin{aligned} KaitzIndex_{p,t} =& \beta_0 + \beta_1[\ln MinWage_t - \ln y_p^{pre2002}(50)] + \beta_2[\ln MinWage_t - \ln y_p^{pre2002}(50)]^2 \\ &+ \delta \mathbf{X}_{p,t} + \beta_p + \beta_t + v_{p,t}, \end{aligned}$$

and the second stage:

$$[\ln y_{p,t}(10) - \ln y_{p,t}(50)] = \alpha_0 + \alpha_1 \widehat{\text{KaitzIndex}}_{p,t} + \alpha_2 \widehat{\text{KaitzIndex}}_{p,t}^2 + \gamma \mathbf{X}_{p,t} + \alpha_p + \alpha_t + \epsilon_{p,t},$$

where $y_{p,t}$ is the hourly wage at the province level and $y_p^{pre2002}(50)$ is the pre-2002 median hourly wage. The Kaitz index, defined as the effective minimum wage at the province and year level, is given by $KaitzIndex_{p,t} = \ln MinWage_t - \ln y_{p,t}(50)$. $y_{p,t}(50)$ is the median hourly wage and $\mathbf{X}_{p,t}$ is a vector of control variables for low-skilled, married and female workers. We also include age and age-squared controls and district FE and year FE. Regarding the validity of our instrument, variation in the national minimum wage is common across all districts, while cross-district differences originate from the predetermined district-level median wage. Therefore, the instrument affects wage inequality only through the effective minimum wage, supporting the exclusion requirement.

In Column (1), we present the first-stage results, which show a statistically significant positive relationship between the instrument $[\ln MinWage_t - \ln y_p^{pre2002}(50)]$ and effective minimum wage. The first-stage regression yields a Kleibergen-Paap F-statistic of 2701028.61 ($R^2 = 0.986$), which confirms the relevance of the instrument. In Column (2), we provide the 2SLS regression results. These results reveal a strong positive response of $\ln y_{p,t}(10) - \ln y_{p,t}(50)$ to changes in the minimum wage. Specifically, a 10% increase in the minimum wage in low-wage districts leads to a 2.65% increase in hourly wages relative to the median. The coefficient on the quadratic term $\widehat{\text{KaitzIndex}}_{p,t}^2$ suggests that further hikes in minimum wage might results in minimal wage compression at the bottom of the distribution. This suggests that while the minimum wage hikes help reduce wage inequality at the bottom end of the distribution and compress wages substantially, further hikes may no longer induce large compression of wages. The latter possibly stems from the presence of informality or hours and employment adjustment at the regional level.

Table 16: **Effects of minimum wage on hourly earnings at the bottom end of the distribution - Kaitz index specification**

	IV First Stage	IV Second Stage
	(1)	(2)
constant	0.026***	1.298***
	(0.002)	(0.008)
$[\ln MinWage_t - \ln y_p^{pre2002}(50)]$	1.090***	
	(0.001)	
$[\ln MinWage_t - \ln y_p^{pre2002}(50)]^2$	-0.045***	
	(0.000)	
$\widehat{\text{KaitzIndex}}_{p,t}$		0.265***
		(0.004)
$\widehat{\text{KaitzIndex}}_{p,t}^2$		-0.179***
		(0.002)
Controls	Y	Y
District FE	Y	Y
year FE	Y	Y
Dependent Variable	$\text{KaitzIndex}_{p,t}$	$[\ln y_{p,t}(10) - \ln y_{p,t}(50)]$
Observations	270992	270992
R^2	0.986	0.056
Adjusted R^2	0.986	
F Statistic	2701028.618***	16063.356***

Notes: Standard errors clustered at the district level are reported in parentheses. *Controls* include age and age squared, female, low skill and marital status dummies. We also control for year fixed effects and district fixed effects, * Significant at the 10 percent level. ** Significant at the 5 percent level. ***. Significant at the 1 percent level. Sample:1992-2021

Appendix D Informality and Wage Distribution

Table 17: **Minimum wage effects on informality along the wage distribution**

	Dependent variable: Informal				
	0-20 (low income)	20-40 (low-middle income)	40-60 (middle income)	60-80 (middle-high income)	80-100 (high income)
	(1)	(2)	(3)	(4)	(5)
constant	3.269***	2.697***	2.726***	3.354***	4.359***
	(0.094)	(0.096)	(0.087)	(0.087)	(0.123)
$\ln MinWage \times Exposure_d^{2002}$	-0.140***	-0.059***	-0.267***	-0.319***	-0.833***
	(0.022)	(0.021)	(0.018)	(0.017)	(0.024)
Controls	Y	Y	Y	Y	Y
District FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Observations	89711	90062	86488	87934	88106
Pseudo R^2	0.060	0.035	0.055	0.109	0.211

Notes: This table reports the response of the indicator variable " informal sector" to the minimum wage along the wage distribution. *Controls* include age and age squared, female dummy, marriage dummy and low educational attainment dummy. We also control for year-fixed effects and district-fixed effects. Robust heteroskedasticity-consistent standard errors are reported in parentheses. * Significant at the 10 percent level. ** Significant at the 5 percent level. ***. Significant at the 1 percent level. Sample:1992-2021

Table 18: **Minimum wage effects on informality, Part-time employment and sectoral composition**

			Industries				
	Informality (1)	Part-time (2)	Agri (3)	Manufact (4)	Construction (5)	Services (6)	Mining (7)
constant	3.843***	-3.000***	-4.770***	-0.635***	-1.925***	-0.373***	-2.085***
	(0.040)	(0.058)	(0.065)	(0.038)	(0.052)	(0.037)	(0.036)
$\ln MinWage_t \times Exposure_d^{2002}$	-0.029***	0.384***	0.946***	0.071***	-0.327***	0.024***	-0.218***
	(0.008)	(0.013)	(0.013)	(0.008)	(0.012)	(0.008)	(0.007)
Observations	442301	442301	442301	442301	442301	442301	442301
Pseudo R^2	0.182	0.072	0.149	0.023	0.056	0.060	0.129
Controls	Y	Y	Y	Y	Y	Y	Y
Average Marginal Effects of $\ln MinWage_t \times Exposure_d^{2002}$							
Outcome	Informality	Part-time	Agri	Manufact	Construction	Services	Mining
AME_{fmt}	-0.0050***	0.0269***	0.0513***	0.0114***	-0.0297***	0.0041***	-0.0429***
SE_{fmt}	(0.0014)	(0.0009)	(0.0007)	(0.0013)	(0.0011)	(0.0014)	(0.0015)

Notes: Table shows the results of logit models with heteroskedasticity-robust standard errors reported in parentheses.The dependent variables: *Informality*, *Part-time*, *Agri*, *Manufact*, *Construction*, *Services* and *Mining* are binary variables. *Controls* include age and age square, female dummy, low education attainment dummy, and marital status dummy. Covariates are selected using L1- penalized logit. * Significant at the 10 percent level. ** Significant at the 5 percent level. ***. Significant at the 1 percent level.