Impact of Minimum wages on wage quantiles: Evidence from developing countries

Uma Rani, Setareh Ranjbar*

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1 Introduction

In developing countries, minimum wages have the potential to reduce inequality and distribute income to low paid workers, so as to ensure that it meets their basic minimum needs. From a policy perspective, minimum wage is an important labour market instrument and is often introduced with a clear welfare objective of raising the wages of low-paid workers and improving the wage/income distribution (Belser and Rani (2015)). However, there has been an over emphasis on the employment effects of minimum wages in the literature, which has to a large extent overshadowed the redistributive impacts and its effects on the wage distribution. The literature focusing on employment effects often also ignores the impact of minimum wages on the wage distribution, wherein some of the low wage workers potentially earn better wages due to the existence of minimum wages or increase in minimum wages. In this regard, Dickens et al. (2012) recently have pointed out that "if the impact on wage inequality and not employment is the first-order effect of the minimum wage then the existing literature on the minimum wage has been poorly focused" (p.1).

There is a renewed interest since the 2008 economic crisis on minimum wages as a useful and relevant policy tool as more and more countries experience increase in both income and wage inequality. A number of emerging and developing economies have been more active in revising the minimum wages on a regular basis and even in advanced countries, like Germany the UK and the USA minimum wages have gained importance to address income inequality. There has been some effort in studying the impacts of minimum wage increases or the introduction of minimum wage in advanced countries, but there is no systematic analysis on the impact of minimum wages on the wage distribution across developing countries. In this context, this paper makes an attempt to analyse the impact of

*The authors are Senior Development Economist, Research Department, International Labour Office Geneva and Ph.D Researcher, University of Geneva respectively. We would like to thank Profs. Jaya Krishnakumar and Stefan Sperlich, and Mark Hannay, University of Geneva; Patrick Belser, Marianne Furrer, Najati Ghosheh, Sangheon Lee and Christian Viegelahn, ILO and Prof. Tim Gindling, University of Maryland Baltimore County for their helpful discussions on the methodology and comments on an earlier draft of the paper. We would also like to acknowledge the comments and discussions provided by the participants at the Conference on "Reforming Minimum Wage and Labour Regulation Policy in Developing and Transition economies", Beijing Normal University, Beijing, October 17th-18th, 2014. All errors and omissions are the sole responsibility of the authors.

minimum wages on wages of workers at the different quantiles of the wage distribution for five developing or emerging economies (Brazil, India, Indonesia, Mexico and South Africa) using the quantile regression approach. At the outset, we would like to mention that we do not look at the effects of an increase/decrease of the minimum wage over time or the introduction of a new minimum wage. We only analyse the impact of existing minimum wages on the wages of workers at the different quantiles of the wage distribution over two points of time.

The paper is organised as follows. A brief review of literature on the effect of minimum wages on the wage distribution is presented in Section 2. Section 3 provides a description of the minimum wage setting mechanisms in the different countries under analysis and tof he data sources. This is followed by a discussion of the methodology adopted to look at the effects of minimum wages at the different quantiles of the wage distribution. Section 4 examines the distribution of wages around the minimum wages for wage workers (across gender, formal-informal sector, industry groups) using kernel density estimates. We then estimate the marginal effects of minimum wages at different quantiles using the quantile regression approach. The final section concludes.

2 Effect of minimum wages on the wage distribution: A Review

Over the past two decades, a fairly extensive body of empirical research exploring the effects of minimum wages on the wage distribution has emerged, though it is limited to certain countries and regions. The rising earnings and wage inequality in the United States of America (USA) in the eighties generated a lot of debate among economists to understand the causes of inequality. The growing disparities were identified to be either due to demand side factors (skill-biased technological change, international trade and rising skill-premiums) (Autor et al. (1998); Wood (1995); Bound and Johnson (1992)); supply-side factors (immigration of less skilled workers) or institutional factors (de-unionisation, declining real value of minimum wages (DiNardo et al. (1996)) (Lee (1999)).

Card and Krueger (1995) examined the impact of minimum wages on the wage distribution with an identifying assumption that the binding (relative) minimum wage (the maximum of the federal and the state-specific minimum rate) is uncorrelated with the changes in latent wage inequality across States. Their findings showed that an increase in minimum wages leads to an increase in average wages at the lower end of the distribution. DiNardo et al. (1996) in their analysis for the period 1979 to 1988 in the USA used the counterfactuals[1] of the distribution with the observed wage densities and found that the rising inequality at the lower end was due to the erosion of real minimum wages during this period. The analysis also showed that the minimum wage was responsible for 25% of the increase in wage dispersion. Lee (1999) adopted similar assumptions[2] as

[1]They construct the counterfactual wage distribution which accounts for the impact of changing work characteristics, labour demand, level of unionisation and minimum wages on the shape of the wage distribution.

[2]The assumption was that latent wage inequality is uncorrelated with the measures of the centrality of states log wage distribution, assuming no endogeneity problem.

Card and Krueger (1995) and showed that the decrease in real minimum wage could explain virtually the entire increase in wage inequality during the 1980s. This finding was also confirmed by Teulings (2003) who used a different methodology and reached similar results. His results showed that the 10-50 log wage differential increased by atleast 10 percentage points, if the log minimum wages relative to the median wage reduced by 0.335.

Neumark et al. (1999) argued that DiNardo et al. (1996) and Lee (1999) focus more on "how minimum wages 'sweep up' workers in the bottom tail of the wage distribution, as opposed to an analysis of the effects at different points of the wage distribution" (p.6). They examined the effects of minimum wage changes by regressing on wages and other control factors at different points of the wage distribution (defined in terms of multiples of minimum wages) for the USA for the period 1979 to 1997, instead of analysing the effects at the bottom tail of the distribution. Their analysis showed that minimum wages increased wages of the lowest wage workers, and wages declined for workers initially earning higher wages. However, the wage losses at the upper end of the wage distribution were smaller in percentage terms than gains at the lower end. Autor et al. (2010) also estimated the structural effects of the minimum wages by regressing on wages and other control factors at different points of the wage distribution or wage ratios (P50/P10), where the minimum was nominally non-binding, implying spillovers. Their analysis showed that the erosion of minimum wages resulted in a rise in inequality in the lower tail of the wage distribution. Thus, the empirical evidence for the USA seems to indicate that the erosion of minimum wages since the 1980's could be partly responsible for the rise in earnings inequality and that the minimum wage has the potential to increase the average wages of the low-wage workers.

In the United Kingdom (UK), Dolton et al. (2012) found that minimum wage increases during the period 1999-2007 were associated with a systematic annual reduction in inequality at the lower tail of the wage distribution. However, Dickens et al. (2012) analysing the impact of minimum wage on wage inequality for the period 1998 to 2010 found that the effects at the 5th and 10th percentiles were significant at the 10% level but the effects were insignificant at higher percentiles. The estimated coefficients declined in magnitude with higher percentiles. Analysing with the lagged terms the results were found to be generally insignificant except at the 25th percentile where it was significantly different from zero at the 10% level suggesting that it takes time for the minimum wage to have its full effect further up the wage distribution. This finding also indicates that minimum wage impacts on average wages have a time-lag, and the effects are much more significant after a certain period of time. This could also to an extent explain why earlier studies like Dickens and Manning (2004) found a negligible effect of minimum wage on wage inequality.

The equality-enhancing role of minimum wages is also evident in developing economies. A number of researchers have explored the impacts of minimum wages on the wage distribution in Brazil using different methodologies. Neri et al. (2000) found strong positive effects of changes in the minimum wage across the entire distribution of salaried workers - relatively small for those at the top and high for those below the minimum wage indicating 'spill-over' effects on the wage distribution. Similar findings were also found by Fajnzylber (2001) who regressed at different points of the wage distribution, which was defined in terms of multiples of minima for formal and informal workers for the period

1982 to 1997. The estimated elasticities were found to be as high as 1.43 for those below 0.9 minima and as low as 0.39 for those making more than 40 minima for the formal salaried workers. The effects were also positive and significant over the entire wage distribution for the informal salaried workers suggesting strong spill-over effects, though the total effects were smaller than that of formal salaried workers. The impacts were similar for the self-employed workers.

Analysing for a later period, 1996 to 2001, Neumark et al. (2006) showed that minimum wages pushed up wages at the bottom of the wage distribution, as it was binding for many low-wage workers but there was no impact on wages of workers at higher quantiles. The exclusion of time effects increased the impact on wages for formal sector workers and the impacts declined further up the wage distribution. When formal and informal sector workers were combined with time effects, then the effects were positive and significant till the 20th percentile and afterwards there was a decline, while for the formal sector it was positive only at the 10th percentile. Lemos (2007) examined the impact of minimum wages for the entire period 1982 to 2000 and concluded that minimum wages strongly compresses the wage distribution of both sectors. The wage effect decreased throughout the distribution in the formal sector, while in the informal sector it first increased and then decreased. In the formal sector, a 1% increase in the minimum wage increased the wages of those in the 25th percentile by 0.33% and of those in the 50th percentile by 0.10%, while in the informal sector it increased by 0.31% and 0.48% for the 25th and 50th percentile. The wage effect at the 10th percentile was insignificant suggesting that the wages of the poorest in the informal sector were unaffected by the minimum wage legislation.

For Indonesia, Chun and Khor (2010) showed that minimum wages had significant effect on wages at the bottom end of the distribution, in both years (1993 and 2000). Their analysis showed that a 10% increase in minimum wages would lead to a 14% increase in real wages for those earning below 90% of the minimum wage, but that there were no significant effect for those earning around or above the minimum wages. Similarly, Lukiyanova (2011) found that the minimum wages accounted for most of the decline in inequality at the bottom end of the distribution in Russia for the period between 2005 and 2009. She found that about 50% of the compression of the lower tail inequality is due to the increase in the real value of minimum wages.

A number of other studies also found strong evidence of positive spill-over or "lighthouse" effects of minimum wages on the uncovered sector (Fajnzylber (2001); Maloney and Mendez (2004)). However, Gindling and Terrell (2004) found that an increase in minimum wages only raised the wages of workers in the urban formal sector (large urban enterprises) who are covered by minimum wage laws but do not have a significant impact on wages in the uncovered sector in Costa Rica. Similarly, Alaniz et al. (2011) in their analyses of the impact of minimum wages on average wages in Nicaragua found that the impact was more significant in large private sector firms than in small firms for full-time workers within 20% of minimum wages.

Minimum wages could also be regressive, as was found in Colombia during 1984-2001 During this period minimum wages only improved the earnings of those in the middle and upper part of the income distribution (Arango and Pachon (2004)). This could be

due to the level at which minimum wage was set, which was high. During the 1980s and early 1990s, when the minimum wages were low, inequality had declined, but with high minimum wages inequality increased. Similarly, the erosion of minimum wages could also lead to an increase in inequality, and it could worsen in countries where minimum wages acts as a numeraire. In Mexico, minimum wages are used not only for setting wages for low paid workers, but also for higher paid workers or other occupations whose wages are set at multiples of the minimum (Fairris et al. (2008)). This linkage suggests that the declining real value of the minimum wage over the past two decades might account for a part of the growing wage inequality. Bosch and Manacorda (2010) showed that between 1989 and 2001 when the Mexican minimum wage declined by about 50% relative to median earnings, a 10 percentage point (p.p.) increase in effective minimum wage raised earnings at the bottom deciles by about 7 p.p. and median earnings by around 3 p.p. They also showed that the erosion of the real value of minimum wages had led to an increase in inequality in the bottom end of the distribution, and "municipalities that experienced a greater increase in inequality also experienced a greater fall in the effective minimum wage"(p.144).

The empirical evidence on impacts of minimum wages on the wage distribution shows that in developing countries minimum wages have a larger potential to shape the wage distribution than in advanced countries. There is also evidence of positive spill-over effects of minimum wages. In developing economies, the minimum wage effects are found to be high for workers around the minimum wage and also moving up the distribution, and they seem to die-off much more slowly than in advanced economies. For example, in the USA, the marginal effects of a 1% increase in minimum wages are only around 0.06% between 2-3 minimum wage, while in Colombia it is 0.38% up to 4 times the minimum wage (Maloney and Mendez (2004)). This suggests that minimum wages, if set at the right level could have a positive effect at the bottom of the wage distribution and could also affect the shape of the wage distribution.

3 Minimum wage settings, methodology and data sources

3.1 Minimum wage settings in the countries under analysis

In studying the impacts of minimum wages on the wage distribution, it is important to understand how minimum wages are set or determined in a particular country. The mechanism of fixing minimum wages helps us to assess whether there is policy endogeneity while analysing the impacts of minimum wage (Boeri (2012)). The International Labour Organisation (ILO), through its Article 3 of the Minimum Wage Fixing Convention 1970 (No.131), advises its member countries to take into consideration two important elements while determining the minimum wages in their respective country. These include: (i) social criteria, that is the needs of workers and their families, which should take into account the general level of wages in the country, the cost of living, social security benefits, and the relative living standards of other social groups; and (ii) economic factors, which should take into account the requirements of economic development, levels of productivity, and the desirability of attaining and maintaining a high level of employment (Belser and Sobeck (2012)). It also advises the Governments to set up the minimum wages in

consultation with the social partners, that is the workers and the employers[3].

Though one would expect countries to take into consideration all these aspects while fixing the minimum wages, in reality not all elements are taken into consideration and the level of consultation also varies within and across countries. In practice, we find that countries have minimum wages that are either legislated by Government alone; by the Government upon consultation with social partners; or by Government following the recommendation or consultation of a specialized body or agency; or through Specialized body; or through collective bargaining agreements (ILO (2013)). As a result, despite what is laid down in the Convention there is a wide variation across countries in fixing minimum wages.

In the countries under analysis, in India, Indonesia and South Africa minimum wages are legislated by the Government following the recommendation or consultation of a specialized body or agency. All these countries have different mechanisms of setting minimum wages, which are at industry or sectoral level, regional or provincial level and national industry/sectoral collective bargaining agreements. The minimum wage system in India is fairly complex as minimum wages are set for unskilled workers in certain "schedules of employment" in each state and, as a result, not all workers are covered by minimum wages. In India, 48 minimum wages rates are set for different job categories in agriculture, mining, oil extraction or any corporation under the ownership of the Central Government, while the various State governments determine wage rates for 1,679 job categories among sectors "scheduled" (or listed) in the Act. Legal minimum wages are set in each state by occupation or industry groups. As a result, the minimum wage fixation procedure differs across these categories. Even within a particular occupation and in a particular State, like brick kilns in West Bengal we find that minimum wage fixation is done both through Government notification and through collective agreements.

The minimum wage in Indonesia is set at the provincial level and it is applicable to all workers, including piece-rate and freelance workers, except for domestic workers. Minimum wages are also set at the district and sub-district levels, and within provinces and districts there are also sectoral minimum wages, where the minimum wages are supposed to be at least 5% higher than the respective province or district minimum wage. Since the decentralization in 2001, the level of the minimum wage has been calculated by the local Governments and then proposed to the provincial government by a tripartite wage council, including representatives from labour, Government and the private sector. Typically, the lowest minimum wage proposed by the local governments in a given province is chosen by the provincial government (Comola and de Mello, 2009). However, anecdotal evidence suggests that labor unions may possibly play a part in determining the level of minimum wages (Chun and Khor, 2010). In South Africa, the Government sets minimum wages through so-called "sectoral determinations" in sectors characterized by a non-unionized and vulnerable workforce. This system has often been implemented to compensate for the absence of collective bargaining in some sectors (ILO, 2008). In South Africa, the minimum wage setting body, known as the Employment Conditions Commission (ECC), advises the Minister of Labour on appropriate and feasible minimum wages for different sectors or sub-sectors in the economy. Currently, the economy has in place 11 such sectoral minimum wage laws in sectors ranging from agriculture and domestic work, to retail

[3]See Section II of the Minimum Wage Fixing Recommendation (No.135) for more details.

and private security. However, in certain occupations like "contract cleaning', minimum wages are sectorally determined by the ECC and also through collective agreements in certain regions.

In Mexico minimum wages are determined by a Specialised body and are also set for occupations and regions. In Mexico social benefits, pensions, fellowships, and even fines are expressed in multiples of minimum wages (Bosch and Manacorda, 2010). Over the past decade, minimum wages ceased to be a nominal anchor as there was a solidarity pact wherein the unions accepted wage moderation in exchange for "social transfers and price capping" (Zapata (2000) in (Bosch and Manacorda, 2010)). In Brazil minimum wages are legislated by the Government alone and are linked to social security benefits. The Brazilian State increases minimum wages annually following the simple rule of applying the rate of inflation plus the GDP growth recorded over the past two years (de Regil (2010)). The national minimum wage is applicable to all workers in the private sector, explicitly including rural workers and domestic workers. Although the legislation does not apply to the public sector, the law on public servants provides that no public servant shall receive a remuneration lower than the minimum wage.

The analysis of minimum wage setting in different countries show that probably the problem of policy endogeniety might not exist in the countries under analysis as minimum wage is set not just based on social and economic factors, but at times could also be politically motivated. This could in some sense reduce one of the sources of endogeniety in the quantile regression analysis.

3.2 Data sources

We have selected five countries for the analysis as they represent different systems of minimum wages, different levels of development, different institutional environments and have varying proportions of wage workers. This apart, the proportion of workers covered by minimum wage decree/orders and level of compliance across these countries are also different, which is another reason for the choice of countries. These countries are Brazil, India, Indonesia, Mexico and South Africa. The data sources used for the analysis are based on the micro data available from household or labour force surveys[4] for the respective countries at two points of time, mid-2000's and late 2000's.

We take into consideration the full complexity of minimum wages in our analysis. Every worker in the data set was assigned a legal minimum wage if the occupation or sector or industry in which the worker was employed had been legally covered by the official decree of the respective country. In Brazil and Mexico, the analysis is undertaken for all wage workers as they are covered by minimum wage legislation, while in India, Indonesia and South Africa the analysis has been undertaken only for the sub-sample of wage workers who are covered by the minimum wage legislation. The dependent variable is real hourly wages for all the countries and for the two years under analysis. The base

[4]Most countries have either labour force surveys or household surveys available for analysis. However, the information required for the purpose of this analysis was similar in both the surveys and they are representative. As a result, there are no adverse implications of using different surveys for this set of countries.

year for calculating the real wages for all countries is 2005[5]. The independent variable is the effective minimum wage[6] and the covariates comprise of age, age-squared, sex, marital status, region (rural or urban areas), ethnic groups, sector (formal or informal), education levels and industry group. Appendix 1 presents data sources, a list of variables and their definitions, and also mentions the reference group for each of the categorical variables. The analysis is undertaken for all individuals aged 15-64 years in the sample. The kernel estimates and quantile regressions are analysed only for wage workers who are covered by the minimum wage legislation, except when specifically mentioned.

3.3 Methodology

As observed in the literature review, over the past decade a number of researchers have evaluated the impact of minimum wages on wage inequality. Variety of methods have been adopted to analyze the impacts with different complexity and precision. The methods also differ depending on underlying labour market assumptions, the policy target group, the objectives and the level of data analysis (aggregate or individual level). The motivation of these analyses also varies from the policy evaluation point of view, as some researchers evaluate the effect of a new minimum wage policy or a sudden increase in the existing minimum wages. Most of the studies evaluating the impact of minimum wages on wage distribution use different ordinary least squares fits and analyze the changes in the minimum wages on earnings by allowing for different effects along the wage distribution and lagged effects (Neumark et al. (2000); (Lemos, 2007)), while some have used 2SLS to model the counterfactuals and more recently Autor et al. (2010) have used the quantile regression approach.

As we are interested in evaluating whether minimum wages are effective in reducing the wage inequality for wage workers who are covered by the minimum wage legislation, we focus on evaluating the marginal effect of an increase in the real minimum wage at different points of the wage distribution. This helps us to understand how minimum wages lead to a change in wage inequality. A number of other studies have also focused on evaluating the effects on the scale of the wage distribution, e.g. Card and Krueger (1995); Lee (1999) and Dickens and Manning (2004).

To analyze the effect of minimum wages on wage distributions, we first explore the behaviour of wages around the minimum wages using kernel density estimates. We then provide additional empirical evidence on the marginal effects of minimum wages around different quantiles using the quantile regression approach.

3.3.1 Kernel Density estimation

To study the behaviour of the wage distribution around the minimum wages, we use the Kernel density estimates wherein we estimate the distribution of the difference between log wages and log minimum wages for each individual (wage worker), similar to

[5]See tables 6 and 7 in the Appendix for details about the computation of hourly real wages and CPI index.

[6]See next sub section.

Gindling and Terrell (2004).

$$x = \log \text{ (hourly real wage)} - \log \text{ (hourly real minimum wages)}$$

We use the weighted[7] kernel density estimation, and the optimal bandwidth in each case is estimated using the robust plug-in method. The kernel estimates provide us with the unconditional wage distribution around the minimum wage for the entire sample population and for sub-groups (by gender, formal-informal workers and industry groups). We find this technique very useful in countries where the minimum wage setting is quite complex and where a number of minimum wages by sector and occupation exists, e.g. India, Indonesia and South Africa. The shape and spikes of the distribution around the vertical zero line illustrate the behaviour of the wages around the minimum wage, and the area below the line indicates the proportion of workers who are earning less than the minimum wage.

The kernel density estimates help us to see if there are spikes in the wage distribution around the minimum wages, which in a sense indicates whether minimum wages are binding or not. However, the evidence of spikes could also be due to a number of other reasons, like clustering around discrete levels of human capital, or due to certain occupational wages. This could also be due to the level at which minimum wage is set. Although the kernel estimates provides the behaviour of wage distribution around the minimum wages, it does not tell us much about the marginal effects of minimum wages at different parts of the wage distribution. For this we need to go beyond the descriptive and use regression techniques.

3.3.2 Quantile wage regression

The ordinary least squares (OLS) method provides an estimation of the conditional mean, which allows us to estimate the marginal effect of the predictors (explanatory variables) on the mean of the responses. In the case of a continuous response variable, if one is interested in finding the marginal effect of predictors on the entire distribution, the conditional mean does not provide a complete answer. As we are interested in understanding whether exogenous variables influence the parameters of the conditional distribution of the dependent variables other than the mean, we use the quantile regression approach. Quantile regression allows for a complete characterization of the conditional distribution of the dependent variable (Koenker and Bassett (1978)).

In the OLS method, the conditional mean can be derived through minimizing the sum of square residuals whereas, conditional median estimates can be derived through minimizing the sum of absolute residuals. This idea could simply be expanded for the estimation of other conditional quantile, as it minimizes a sum of asymmetrically weighted absolute residuals, and it provides different weights for the positive and negative residuals for each quantile (Koenker and Bassett (1978)). In fact, the quantile regression approach enables us to estimate at different points in the wage distribution i.e it allows for a non-linear association between the chosen minimum wage indicator and log of real wages, while the OLS regression estimates only the mean effect on the dependent variable.

[7] Weighting the observations by their survey weights.

The quantile regression approach that we adopt in this paper uses the idea introduced by Koenker (2005). In the same way as a mean square error problem one can define the conditional quantile function as a solution to the following minimization problem:

$$Q_\theta(Y_i|X_i) = \arg\min_{q(\mathbf{X})} E[\rho_\theta(Y_i - q(X_i))] \tag{1}$$

where $\rho_\theta(.)$ provides asymmetrical weights on positive and negative residual, which follow:

$$\rho_\theta(u) = \mathbf{1}(u > 0).\theta|u| + \mathbf{1}(u \leq 0).(1-\theta)|u|$$

where $\mathbf{1}(.)$ is the indicator function. Substituting $q(X_i)$ by a linear model, i.e. $q(x_i) = X_i^T\beta$, allows transforming this minimization into an easier linear optimization problem, which can be solved through iterations. This then provides:

$$\beta_\theta = \arg\min_{\beta} E[\rho_\theta(Y_i - X_i^T\beta)]$$

The quantile regression gives the median regression where θ=0.5. The first quantile is obtained by setting θ=0.20 and so on. As one increases θ from 0 to 1, one traces the entire distribution of Y conditional on X. Thus, quantile regressions provides snapshots of different points of a conditional distribution.

The empirical results are obtained by using the following mincerian wage equation in the quantile regression framework:

$$Quant_\theta(ln(w_i) \mid X_i) = \beta_0^\theta + \beta_1^\theta X_i + \beta_2^\theta(MWindicator_i) \tag{2}$$

where $ln(w_i)$ indicates the log of hourly real wages. The β_j^θ's are the coefficients of the wage regression at θth conditional quantile of $ln(w)$ given all explanatory variables.

The minimum wage indicator in Equation (2) is defined at the individual level:

$$MWindicator(\text{Effective Minimum wages}) = \ln(\frac{\text{Minimum wages}}{\text{Median of wages}})$$

The minimum wage is assigned to each individual according to the legislation or labour decree of each country. It is divided by the median wages of those workers who are covered by the legislation. The log of this ratio provides the difference of an individuals' log of real minimum wages from the log of the median wages, which is kaitz index. We refer to this indicator as effective minimum wage in this paper. We do not trim the means by excluding top and bottom quantiles as opposed to some researchers (e.g., Lee (1999)). In Equation (2), the vector of personal characteristics, X_i, comprises of age, age squared, gender, ethnic groups, education levels, marital status, regions (rural or urban), industry dummies and sector (formal or informal).

The main challenge that arises when analyzing the effect of minimum wages on wages, either on average or on the entire distribution, is dealing with the potential endogeneity problem and its consequent bias in the estimation of the effect. The endogeneity problem can arise from different sources: omitted variables, measurement error and simultaneity. For this analysis, the argument lies in the fact that common macro level economic factors can simultaneously influence wages and the minimum wages of an individual. As we take

into consideration the detailed minimum wage mapping at the individual level according to the minimum wage setting, this might reduce the problem. To address this and to check for robustness, we included GDP growth at the state level as a macro level determinant of wages for two years for India. The results of the coefficients are almost similar (see Appendix table A.3). This could be because we also control for characteristics including industry status and region where the individual is working, which might capture the regional variation of GDP (figure A.1 in Appendix).

Some researchers have also argued that spill-over effects of minimum wages on uncovered workers must also be taken into consideration as a measurement issue, as it could be another source of endogeneity bias (Autor et al. (2010)). We are prone to the measurement error as pointed out by these researchers as we are limiting the analysis to only those who are covered by minimum wage legislations.

Some studies have also used time and state or region dummies to control for endogenous changes (Bell (1997); Neumark et al. (2000)). Gindling and Terrell (2004) include dummy variables for each year to control for endogenous changes in yearly average minimum wages and timing of minimum wage changes. Some others have also tried to use instruments for addressing the endogeneity problem: Autor et al. (2010) used a two-stage least squares method, wherein they instrument the effective minimum with the statutory minimum wage in each state and year. The assumption is that this instrument will capture exogenous variation in the effective minimum that are uncorrelated with the measurement error in state medians. As we use the detailed mapping of minimum wages within each country, we do not find it essential to simulate the variation by using the state or industry specific median wages. In addition, the dummy variables for industry categories and state are incorporated as controls in the regressions.

However, it is also possible that the endogeneity problem is reduced as we use the detailed minimum wages at the sectoral and industry level instead of using simple national level minimum wages. The technique we employed to map is time-consuming but it provides a desirable variation in minimum wages at the individual level. This is especially true in the case of India, Indonesia, South Africa and Mexico where there are multiple minimum wages at state, sectoral and occupational level. Further, to test for the endogeneity problem, we repeated the analysis taking the lag of the minimum wage indicator[8]. The results are presented in Appendix table A.4. The results are quite consistent to those without lags (both in terms of the direction and the magnitude of the marginal effects), which to an extent assures us that we can ignore the threat of endogeneity, as it is likely that the minimum wages and wages are not determined in a similar way (figure A.2 in Appendix).

Estimated marginal effects at each 20% quantile and at every 5% quantile are computed and then plotted against the related quantile (figure 2). The crucial point in the analysis of the effect of minimum wages on wage inequality lies in the interpretation of the marginal effects. In situations where the marginal effect is positive in the lower quantile but decreases to be negative in the upper quantiles, we can deduct that as a result of an increase in the effective minimum wage the inequality would reduce.

[8]The estimates with lag is only done for Brazil as the minimum wage mechanism is comparatively simpler than in other countries, and it is easy to implement within a short period of time.

We repeat the analysis separately over the sub-sample for formal and informal sectors to compare the behaviour of the minimum wage effects in these sectors. Finally, for India we analyse the impact of minimum wages on all workers irrespective of whether they are covered or not by the minimum wage legislation. For those workers who are not covered by minimum wage legislation we assign the state level minimum wages, and estimate the marginal effects at the different quantiles in the same way as described above.

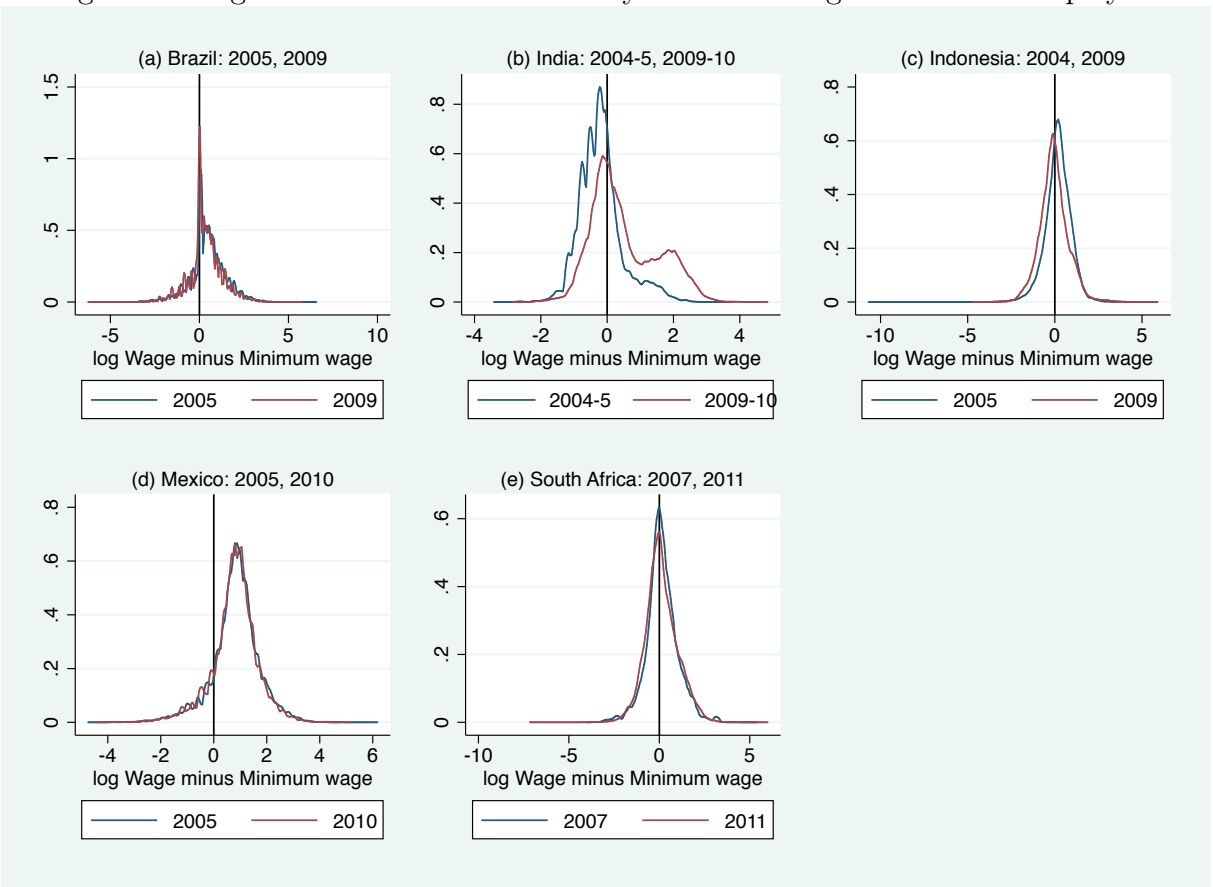
4 Effects of minimum wages on the wage distribution: Empirical evidence

In developing countries, wages do form an important source of income in households and minimum wages could play an important role in arresting the erosion of average wages in the face of stiff competition and excess supply of unskilled labour. However, the potential redistributive role of minimum wages can be undermined in developing countries if the incidence of self-employment and unpaid family work is quite high and if not all workers are covered by minimum wage legislation. In the countries under analysis the proportion of wage workers varies from 40% in Indonesia to over 80% in South Africa. All workers in Brazil and Mexico are covered by minimum wage decrees/orders; in Indonesia 95% of the workers are covered (excluding domestic workers); and in India and South Africa 70 and 72% of the wage workers are covered respectively.. The effectiveness of minimum wage is critically dependent on the coverage of workers by minimum wage legislation, the level at which the minimum wage is set and the extent of compliance, which is far from perfect in developing countries (Rani et al. (2013)). Minimum wages can have differential impacts on wages depending on the gender, age, educational attainment and industry group. These differences could arise due to the distinct labour supply behavior across these groups, which are reflected in the nature of employment (formal/informal). To explore the behaviour of wage distributions around the minimum wages we examine the kernel density estimates for different groups of workers, across gender, sector (formal-informal), and industry groups. In this section, we explore the behaviour of wages around the minimum wages using kernel density estimates and the impact of minimum wages around different quantiles using the quantile regression approach.

4.1 Distribution of wages around minimum wages

Figure 1 shows the kernel density estimates of individual wages around the minimum wages. The vertical line at 'zero' is the point where individuals earn equal to their minimum wages, and the values below (above) implies that the workers earning below (above) the minimum wages. In an earlier paper (Rani et al. (2013)) we examine whether there are spikes in the wage distribution at or around the minimum wages for wage workers for a broader set of 11 developing countries. The evidence of spikes at the minimum wage levels was quite mixed across countries, with majority of countries showing significant spikes at or around minimum wages (Brazil, Indonesia and South Africa), with no evidence of a spike in some others (India, Mexico).

Figure 1: Wage distributions and statutory minimum wages of covered employees



The spike in the distributions near zero indicates whether the minimum wages are more or less binding. When comparing the distributions over time, minimum wage have become more binding in Brazil compared to other countries. The spike at the minimum wages in Brazil could be due to minimum wages being an anchor of the labour market, based on which other occupational or provincial wages are set. However, in other countries it was less binding or remained more or less the same. If we look at the fraction of workers earning around 90 to 110%, it has remained more or less same for Indonesia and has become less binding in South Africa by 2%. In general, except for India, the distribution of wages around minimum wage has not changed much for the two years under analysis. The shift in the kernel density estimates in 2009-10 in India could be due to the huge improvement in the compliance of the minimum wage, which increased from 31.1% in 2004-5 to 61% in 2009-10 (Rani et al. (2013)). Interestingly, in India we observe a bimodal distribution for the second year (2009-10), unlike in other countries. In Mexico, there is no evidence of a spike in both years around the minimum wages, which indicates the level is set at a lower level. As a result, the real value of minimum wages has also declined and it has lost its value as an nominal anchor in the labour market (Bosch and Manacorda, 2010).

The kernel estimates are also provided by gender and different industry groups in the Appendix. If we take into consideration kernel density estimates for gender (figure A.3 in Appendix), we find that there is a spike at the minimum wage for both male and female workers in Brazil and South Africa, and for males in India and Indonesia in the second

year. There is not much difference in the wage distribution for male and female in Brazil for both years. In contrast, in India and Indonesia female wage distribution is much more skewed to left than that of males, indicating a comparatively higher proportion of female workers earning less than the minimum wage.

Across the industry groups (figure A.4 in Appendix), an evidence of spikes in the wage distribution around the minimum wage level displays interesting picture. In Brazil, if we look at the wage distribution for the different industry groups, there is a spike at the minimum wages for all workers except for those in manufacturing sector and low-skilled sectors in both the years. The wage distribution of the workers in the manufacturing sector is highly skewed towards right, as majority of workers earns more than the minimum wages in 2004-5. In India there is no spike around the minimum wages for 2004-5, but there is a spike around the minimum wages for agricultural workers in 2009-10. In Indonesia there is a spike around minimum wages for agriculture, manufacturing and construction in 2009, and in South Africa there is a spike around the minimum wages only for agricultural workers in 2011. The low levels at which the minimum wages are set in Mexico leads to a skewed wage distribution as majority of the workers have wages above the zero line.

There is increasing evidence that shows that minimum wages influence the wage distribution of workers in the informal sector (Khamis (2008); Gindling and Terrell (2004); Rani et al. (2013)). This has also led to a shift in understanding the potential impact of minimum wages in the informal sector (figure A.5 in Appendix), compared to the earlier notions where minimum wages were supposed to suppress the wages in the informal sector or increase employment as a result of losses in formal sector employment. The evidence of spikes at the minimum wages shows different patterns across the developing countries under study for both formal and informal sectors. In Brazil, there is a spike at the minimum wage for workers in the informal sector.

India exhibits the most interesting case. The overall distribution for India is bimodal, which could be due to the differences in the distribution of wages in the formal and informal sector. There is also a significant difference between the two sectors graphically. The differences could arise as the wages in the formal sector are determined by collective agreements or Government statutes. In contrast, for about 70% of the workers covered by the schedules of employment in the informal sector the wages are set up through the various mechanisms, and for the remaining workers it is market determined. This apart, the differences in the wage distribution of formal and informal sector is to a large extent due to the agriculture sector, which comprises to a large extent the low-paid workers (Rani and Belser (2012)). The wage distribution in Indonesia looks similar for both formal and informal sector, and there are no spikes around the minimum wages in 2005. However, in 2009 there is a spike around the minimum wage for formal sector workers due to improved compliance. In Mexico the wage distribution is skewed to the right for both the formal and informal sector workers as majority of the workers are above the minimum wages. In South Africa there is a spike around the minimum wages in 2007, but it is not so evident in 2011.

4.2 Effect of minimum wages on the wage quantiles

To analyse the marginal effect of the minimum wages at different quantiles, we run the quantile regression of log hourly real wages on the effective minimum wage and the vector of personal characteristics. The marginal effects of the regression are presented at 20%, 40%, 60%, 80% quantiles of the log wage distribution (table 1). As mentioned earlier, the analysis is undertaken for all wage workers in Brazil and Mexico, and for those who are covered by the minimum wage legislation in India, Indonesia and South Africa. As a result, while in Brazil and Mexico all wage workers are distributed across the different quantiles, in India, Indonesia and South Africa only the sample of wage workers covered by minimum wage legislation are distributed across the different quantiles. This could result in marginal effects being higher at the higher quantiles, which needs to be carefully interpreted. The marginal effect of the effective minimum wage, that is the β_2^θ coefficient in Equation 2, gives us the effect of minimum wages on the log of real wages at different quantiles in the wage distribution conditional on the personal characteristics described earlier. The results are presented in table 1 for the two years for all the five countries under the analysis. Figure 2 presents the marginal effects of the effective minimum wage that are computed at every 5% quantile and then plotted against the related quantile.

Table 1 shows that the marginal effects of the minimum wage are significantly positive around the 20th quantile of the conditional wage distribution for all the counties in both years. The marginal effects of the quantile regression in Brazil show that a 1% increase in the effective minimum wage will lead to a 0.20% increase in wages around the 20th quantile, *ceteris paribus* in 2005. This effect reduces at the 40th quantile reaching to 0.07% and is significantly negative in absolute value at the 60th and 80th quantiles. In 2009, the marginal effect is positive and significant across all quantiles in the wage distribution and the magnitude is higher compared to 2005. However the effect is much stronger around the 20th quantile (0.42%) and it declines gradually to 0.07% around the 80th quantile. The results for Brazil indicate that a 1% increase in the effective minimum wage leads to an increase in wages around the 20th quantile, *ceteris paribus* than at the 80th quantile, which could imply that there is a 'squeeze' in the wage distribution. These results are quite consistent with Lemos (2007) who also observed that minimum wages compresses the wage distribution in the eighties and nineties.

In India, the marginal effects for both years are significantly positive for all the quantiles. Across the two years the marginal effects has increased by 0.14% at the 20th and 40th quantile for a 1% increase in the effective minimum wage. The comparatively lower effect in 2004-5 could be due to the lower rate of compliance, which was only about 31.9% (see Rani et al. (2013)). However, with the implementation of the National Rural Employment Guarantee Act (NREGA) in 2005, there has been an effort to ensure enforcement of at least state level minimum wages in rural areas. It is also possible that the average wages in general were also growing due to better economic growth. This seems to have given an impetus for improved enforcement as the compliance rate increased to 61% in 2009-10. The marginal effects of the quantile regression are much stronger at the bottom quantiles and it declines marginally at upper quantiles in 2009-10. A 1% increase in the effective minimum wage leads to a 0.47% increase in wages around the 20th quantile *ceteris paribus*, while the effect around the 80th quantile is about 0.41% in 2009-10 (table 1).

In Indonesia, the marginal effects of the effective minimum wage are high compared

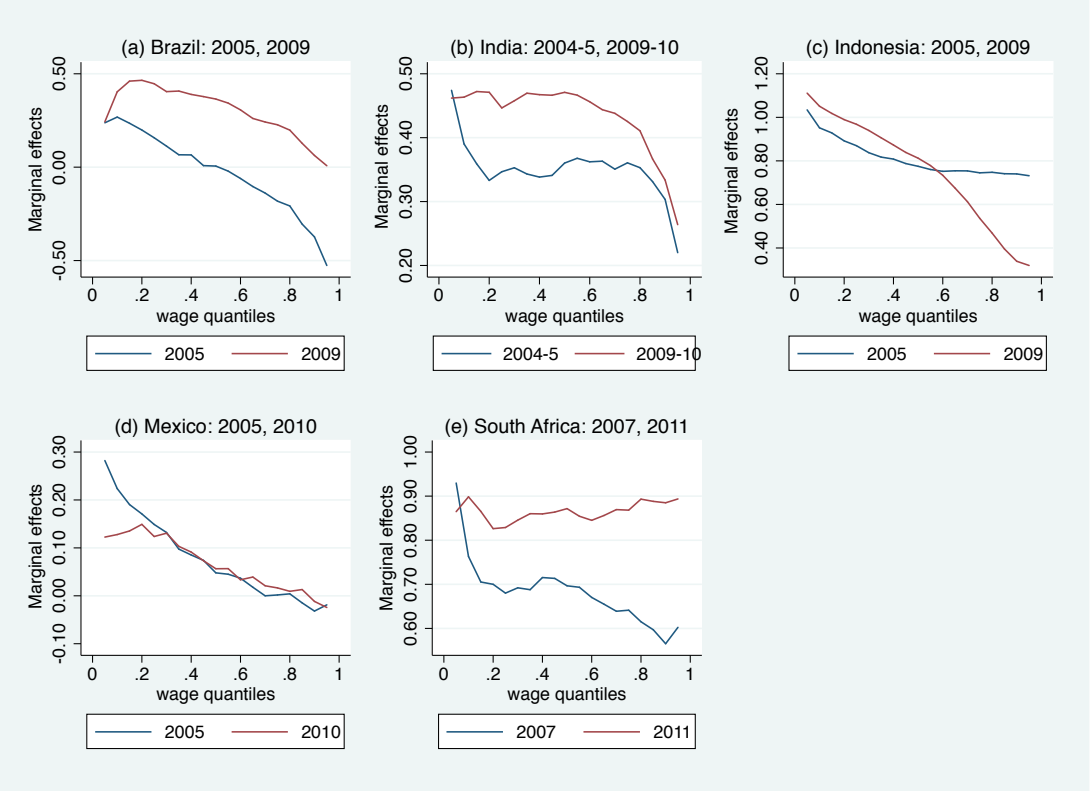
Table 1: Quantile wage regressions, workers covered by minimum wage legislations

	QR20	QR40	QR60	QR80	QR20	QR40	QR60	QR80
Brazil	2005				2009			
Effective minimum wage	0.20***	0.07**	-0.02**	-0.21***	0.42***	0.32***	0.24***	0.07*
Constant	3.24***	3.41***	3.59***	3.66***	4.19***	4.47***	4.80***	5.14***
Observations	116456	116456	116456	116456	122902	122902	122902	122902
Pseudo R^2	0.26	0.27	0.30	0.34	0.26	0.24	0.28	0.33
India	2004-5				2009-10			
Effective minimum wage	0.33***	0.34***	0.36***	0.35***	0.47***	0.47***	0.46***	0.41***
Constant	2.52***	2.84***	3.01***	3.29***	2.83***	3.48***	3.73***	3.96***
Observations	34279	34279	34279	34279	37949	37949	37949	37949
Pseudo R^2	0.29	0.37	0.44	0.51	0.29	0.38	0.47	0.51
Indonesia	2005				2009			
Effective minimum wage	0.89***	0.81***	0.75***	0.75***	0.99***	0.91***	0.76***	0.51***
Constant	7.79***	8.14***	8.40***	8.72***	7.33***	7.88***	8.16***	8.15***
Observations	33881	33881	33881	33881	158366	158366	158366	158366
Pseudo R^2	0.20	0.22	0.23	0.23	0.15	0.19	0.23	0.23
Mexico	2005				2010			
Effective minimum wage	0.17***	0.09***	0.04***	0.004	0.15***	0.09***	0.03***	0.01
Constant	2.68***	2.48***	2.76***	3.10***	2.06***	2.56***	2.88***	3.32***
Observations	78455	78455	78455	78455	74124	74124	74124	74124
Pseudo R^2	0.19	0.21	0.23	0.26	0.20	0.21	0.23	0.25
South Africa	2007				2011			
Effective minimum wage	0.70***	0.71***	0.67***	0.61***	0.83***	0.86***	0.84***	0.89***
Constant	2.94***	3.94***	4.23***	4.50***	3.20***	3.95***	4.46***	4.89***
Observations	7758	7758	7758	7758	40372	40372	40372	40372
Pseudo R^2	0.24	0.26	0.28	0.28	0.21	0.24	0.27	0.29
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Effective minimum wage is defined as the log of Kaitz index

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 2: Effects of minimum wages on wage distributions: All workers



to other countries at all quantiles for 2005. The absolute value of the marginal effects is smaller at higher quantiles than at the bottom. At the 20th quantile, *ceteris paribus*, a 1% increase in the effective minimum wage leads to an increase in the wages of the workers by 0.89% compared to 0.75% around the 80th quantile. In 2009, the marginal effects are quite high at the bottom quantiles (0.99%) but declines to 0.51% around the 80th quantile, and the effects are significant for all quantiles. The high marginal effects in Indonesia could be due to the level of minimum wage, which is quite high for both years compared to other countries (see Rani et al. (2013)). In Mexico, the marginal effects of the effective minimum wages are very low compared to other countries. The plausible reason for such a low effect could be due to the erosion of minimum wages over the past decade. The marginal effects of the effective minimum wage are significantly positive for all quantiles, but the magnitude of these effects are quite low. Despite the erosion of minimum wages, the absolute value of the marginal effects are 0.15% at the 20th quantile and 0.03% at the 60th quantile in 2009-10.

In South Africa, the rate of compliance declined marginally over the two years. The marginal effects of effective minimum wages in 2007 across the different quantiles was comparatively lower, except for the lowest quantiles. Despite reduced compliance, in 2011 the magnitude of the marginal effects of minimum wages are higher across all the quantiles compared to 2007. A plausible reason for the high marginal effects of effective minimum wage could be the minimum wage level, which is high. A 1% increase in the effective minimum wage leads to a 0.83% increase in wages around the 20th quantile, *ceteris paribus* while the effect around the 80th quantile is about 0.89%.

4.2.1 Marginal effects of minimum wage for all wage workers in India

We further try to analyse the impact of the minimum wages on all workers irrespective of whether they are covered by minimum wage legislation or not. To illustrate what the impacts could be we undertake the analysis only for India where the coverage is incomplete. For workers who are not covered by the minimum wage legislation, we allocate the state level minimum wages based on the state in which the worker resides, which are available from the labour bureau on an annual basis. We then run the quantile wage regression for all wage workers. The results are presented in table 3. For 2004-5, the marginal effects of the effective minimum wage increases gradually as we move towards the 80th quantile. A 1% increase in effective minimum wage leads to an increase in wages by 0.23% around the 20th quantile,*ceteris paribus* and by 0.34% around the 80th quantile. The direction of the results are quite similar and the magnitude of the effects are higher in 2009-10 till the 60th quantile but thereafter the marginal effect declines (figure 3). A 1% increase in effective minimum wage leads to an increase in wages by a 0.32% at the 20th quantile, *ceteris paribus* and by 0.34% around the 80th quantile for 2009-10. However, the differences in the marginal effects across the wage distribution is not very big in 2009-10 compared to 2004-5. These results suggests that when all workers are not covered by minimum wages, and there is only partial coverage then wage inequality could increase, as a large proportion of low-paid workers are not able to avail minimum wages. The results are also quite useful for the on-going debate in India about covering all wage workers and making the national or state minimum wage floor binding, so that low-paid workers could benefit.

Table 2: Quantile wage regressions, India (all wage workers)

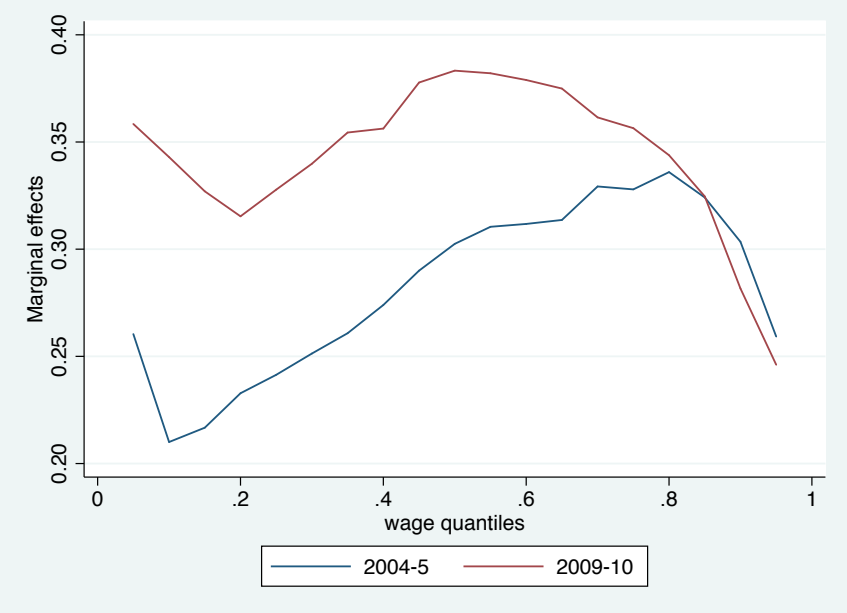
	QR20	QR40	QR60	QR80
2004-5				
Effective minimum wage	0.23***	0.27***	0.31***	0.34***
Constant	2.62***	2.94***	3.16***	3.39***
Observations	79193	79193	79193	79193
Pseudo R^2	0.35	0.42	0.48	0.50
2009-10				
Effective minimum wage	0.32***	0.36***	0.38***	0.34***
Constant	2.90***	3.51***	3.79***	4.02***
Observations	67886	67886	67886	67886
Pseudo R^2	0.29	0.37	0.45	0.48
Controls	Yes	Yes	Yes	Yes

Effective minimum wage is defined as the log of Kaitz index.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.2.2 Effects of minimum wage on formal and informal sector

The literature on legal minimum wages in developing economies generally assumes that minimum wages are likely to be enforced only in larger firms and among unionized

Figure 3: Effects of minimum wages on wage distributions: India for all wage workers



workers in the urban formal sector and enforced weakly or not at all in the rural or urban informal sectors. Rani et al. (2013) also showed that across selected developing countries the compliance rates were higher among workers engaged in the formal sector than in the informal sector. However, despite the weak enforcement of minimum wages in the informal sector, it still has an impact across the quantiles in the wage distribution

The marginal effects of the quantile regressions for the formal and informal sector shows a positive effect of the minimum wages on wages around the quantiles and the effects are quite stronger for the workers in the informal sector compared to the formal sector in Brazil, India and Mexico (tables 4 and 5). These results are quite intuitive in the sense that informal sector wages are in general quite low, so an increase in effective minimum wage would have a positive effect on the wages of informal sector workers than for those in the formal sector workers. In India, comparing the results for the formal and informal sector reveals that the positive effects for the overall sample is mainly due to the informal sector rather than the formal sector. This is not far from expectation as the minimum wage schedule of India is set mainly to protect the informal workers (casual workers) in different sectors. However, in Indonesia and South Africa the marginal effects in the formal sector are stronger or are quite similar across both the sectors. There is no negative marginal effect observed in the regressions for the informal sector.

The marginal effects of the effective minimum wage tends to decline across the quantiles as we move towards the higher quantiles in all countries except Indonesia in the informal sector (figure 5). This could be due to the high level of minimum wage. However, in the formal sector in Indonesia, the marginal effects decline as we move towards 80th quantile (figure 4). Overall, the wages of the workers in the formal sector are comparatively less affected by minimum wages in all countries except Indonesia and South Africa (table 3).

Table 3: Quantile wage regressions, formal sector workers

	QR20	QR40	QR60	QR80	QR20	QR40	QR60	QR80
Brazil	2005				2009			
Effective minimum wage	0.17***	-0.01	-0.14***	-0.35***	0.34***	0.26***	0.16***	- 0.02
Constant	3.59***	3.58***	3.57***	3.49***	4.57***	4.77***	4.94***	5.08***
Observations	70715	70715	70715	70715	79460	79460	79460	79460
Pseudo R^2	0.15	0.21	0.26	0.32	0.12	0.20	0.25	0.31
India	2004-5				2009-10			
Effective minimum wage	0.19***	0.16***	0.15***	0.10***	-0.08	-0.12*	-0.27***	-0.45***
Constant	1.77***	2.45***	2.81***	3.06***	1.27***	1.99***	2.16***	2.40***
Observations	7075	7075	7075	7075	10921	10921	10921	10921
Pseudo R^2	0.31	0.27	0.25	0.25	0.21	0.18	0.15	0.13
Indonesia	2005				2009			
Effective minimum wage	0.97***	0.84***	0.77***	0.72***	1.11***	0.85***	0.65***	0.42***
Constant	7.66***	7.99***	8.17***	8.36***	7.36***	7.77***	7.93***	8.22***
Observations	24881	24881	24881	24881	117725	117725	117725	117725
Pseudo R^2	0.22	0.24	0.26	0.25	0.17	0.21	0.24	0.22
Mexico	2005				2010			
Effective minimum wage	0.08***	0.01	-0.06***	-0.12***	0.05***	0.01	-0.06***	-0.10***
Constant	2.04***	2.39***	2.58***	2.81***	2.01***	2.47***	2.77***	3.12***
Observations	64130	64130	64130	64130	59433	59433	59433	59433
Pseudo R^2	0.16	0.19	0.22	0.24	0.17	0.19	0.22	0.24
South Africa	2007				2011			
Effective minimum wage	0.69***	0.70***	0.67***	0.61***	0.81***	0.85***	0.84***	0.89***
Constant	2.97***	4.03***	4.36***	4.49***	3.38***	4.08***	4.58***	4.89***
Observations	6453	6453	6453	6453	30202	30202	30202	30202
Pseudo R^2	0.16	0.19	0.21	0.23	0.16	0.20	0.23	0.24
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Effective minimum wage is defined as the log of Kaitz index

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 4: Effects of minimum wages on wage distributions: Formal workers

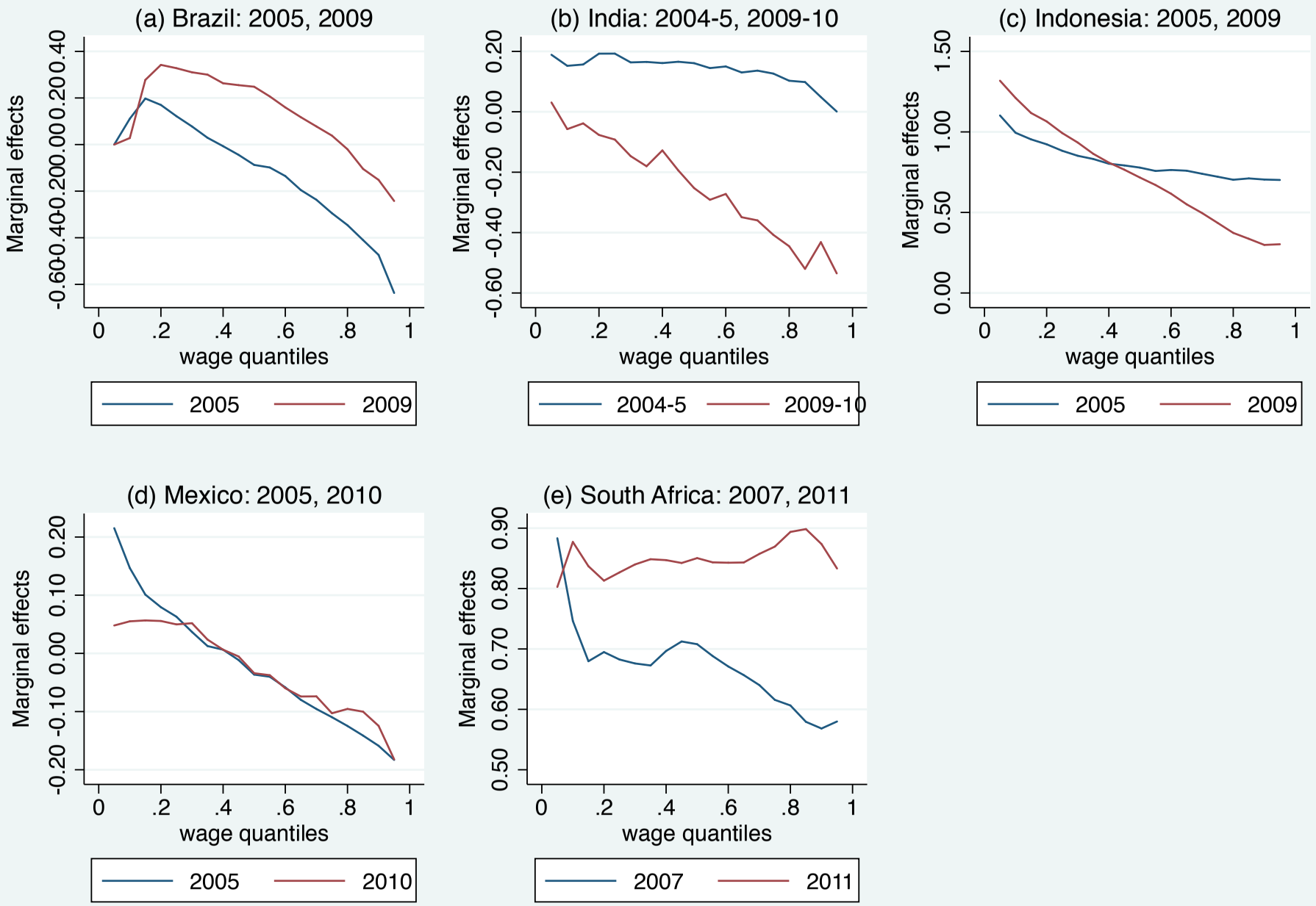


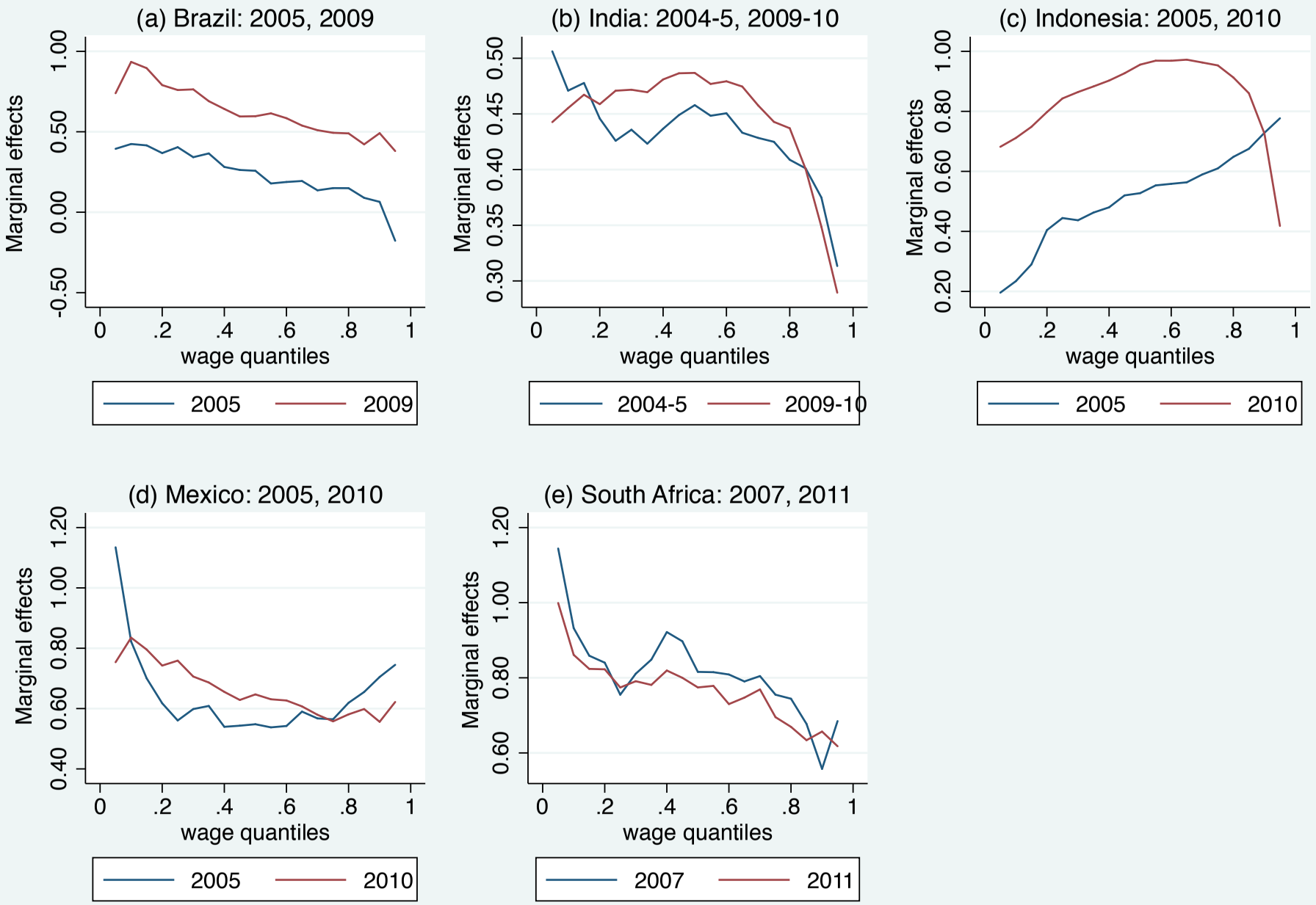
Table 4: Quantile wage regressions, informal sector workers

	QR20	QR40	QR60	QR80	QR20	QR40	QR60	QR80
Brazil	2005				2009			
Effective minimum wage	0.37***	0.28***	0.19**	0.15**	0.79***	0.64***	0.58***	0.59***
Constant	2.16***	2.58***	2.96***	3.17***	2.79***	3.45***	3.98***	4.57***
Observations	45741	45741	45741	45741	43442	43442	43442	43442
Pseudo R^2	0.16	0.16	0.16	0.24	0.17	0.16	0.15	0.23
India	2004-5				2009-10			
Effective minimum wage	0.45***	0.44***	0.45***	0.41***	0.46***	0.48***	0.48***	0.44***
Constant	1.16***	1.59***	1.88***	2.32***	1.27***	1.99***	2.16***	2.40***
Observations	27204	27204	27204	27204	27028	27028	27028	27028
Pseudo R^2	0.14	0.17	0.18	0.21	0.21	0.18	0.15	0.13
Indonesia	2005				2009			
Effective minimum wage	0.41***	0.50***	0.57***	0.66***	0.82***	0.92***	0.99***	0.93***
Constant	6.66***	7.36***	7.98***	8.64***	7.11***	7.55***	8.01***	8.53***
Observations	9000	9000	9000	9000	40641	40641	40641	40641
Pseudo R^2	0.12	0.14	0.13	0.10	0.12	0.12	0.11	0.09
Mexico	2005				2010			
Effective minimum wage	0.62***	0.54***	0.54***	0.62***	0.74***	0.66***	0.63***	0.58***
Constant	1.23***	1.80***	2.13***	2.77***	1.42***	1.94***	2.23***	2.58***
Observations	14325	14325	14325	14325	14691	14691	14691	14691
Pseudo R^2	0.15	0.15	0.14	0.14	0.13	0.12	0.12	0.11
South Africa	2007				2011			
Effective minimum wage	0.84***	0.92***	0.81***	0.74***	0.82***	0.82***	0.73***	0.67***
Constant	1.20***	1.78*	1.28	1.07***	2.56***	2.41***	3.91***	3.99***
Observations	1305	1305	1305	1305	10170	10170	10170	10170
Pseudo R^2	0.09	0.10	0.11	0.16	0.07	0.09	0.11	0.13
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Effective minimum wage is defined as the log of Kaitz index

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 5: Effects of minimum wages on wage distributions: Informal workers



5 Conclusions

This paper has made an attempt to analyse the effect of minimum wages on wages across different quantiles in the wage distribution for five developing economies for two periods of time. The literature reviewed in this article indicates that minimum wages has a positive effect on wages of workers at the bottom end of the wage distribution compared to the top, thus suggesting inequality reducing effects. The empirical evidence reviewed also showed that the effects were much stronger in developing countries compared to advanced ones, and the effects were found to be high and significant moving up the distribution.

The empirical analysis for the five countries shows that with regard to the distribution of wages around minimum wages there is a clear evidence of a spike at the minimum wages in all countries, except in India and Mexico. Across the different categories, for gender spikes at the minimum wage level were found in Brazil and South Africa for both males and females, and only for males in India and Indonesia in the second year. For industry groups there was no clear pattern across these countries for the two points of time: Brazil (except for manufacturing and low-skilled sectors); India and South Africa (agricultural workers in the second year); and Indonesia (agriculture and construction) for the late 2000s. Regarding the sector, the evidence was also quite varied with a spike at the minimum wages for the informal sector in Brazil in both years, but a less clearer picture for other countries for the late 2000s.

The analysis of the marginal effect of the minimum wages at different quantiles shows that despite less than perfect compliance, minimum wages are quite effective in improving the wages of the workers at the lower quantiles in all the countries under study. The marginal effects of a 1% increase in the effective minimum wage for the overall sample around the 20th quantiles varied between 0.15% (Mexico) to 0.99% (Indonesia) in the late-2000s and the marginal effects increased over the two points of time. The reason for this huge variation could be due to the levels at which the minimum wage are set. In Brazil and Mexico, the marginal effects declined gradually moving up the wage distribution, while in India, Indonesia and South Africa the marginal effects remained at almost similar levels albeit declining slowly. This could be because in the latter three countries, as the analysis is only undertaken for the sub-sample of covered workers, they are redistributed across the different quantiles. In Brazil, we find positive effects at the lower quantiles and negative effects at the upper quantiles in the mid-2000s indicating a squeeze in the distribution, and the effects in the late-2000s are positive throughout the wage distribution but they decline gradually. For sectors (formal and informal) the analysis shows that the marginal effects are relatively stronger for the workers in the informal sector compared to the formal sector in Brazil, India and Mexico. However, in Indonesia and South Africa the marginal effects are stronger or quite similar across both the sectors.

Finally, for India the analysis shows that when only a sub-sample of wage workers who are covered by minimum wage legislation are considered then the marginal effects are similar and quite moderate across the different quantiles compared to other countries. This could suggest that there is a potential for wage inequality to decrease as a result of a 1% increase in the effective minimum wage. However, when we take into consideration all the wage workers into the analysis, we find that the marginal effects are compara-

tively low. The marginal effects also increase across the quantiles as we move up the wage distribution. The reason for this trend is largely because a substantial proportion of low-paid workers are not covered by minimum wages or schedule of employment. As a result, due to partial coverage we observe that wage inequality could increase. These results also suggest that for minimum wage to be a useful tool for income distribution, but it is essential that all workers are covered by minimum wages.

Appendix 1: Data sources, variable names and definitions

For the analysis we used the household or labour force surveys for the different countries. For Brazil, we use the Pesquisa Nacional por Amostra de DomicÃlios (PNAD), IBGE for the two years 2005 and 2009; for India we use the Employment-Unemployment survey of the National Sample Survey Organisation for the years 2004-5 and 2009-10; for Indonesia we use the National Labour Force Survey (Survei Angkatan Kerja Nasional) (SAKERNAS), BPS-Statistics for the years 2005 and 2009; for Mexico we use the Encuesta Nacional de Ocupacion Y Empleo (ENOE), INEGI for the years 2005 and 2010; and for South Africa we use the Labour Force Survey for the year 2007 and Labour Market Dynamics Survey for the year 2011.

The detailed characteristics of all workers including sex, age, caste/religion, marital status, relation to the household head, education level, employment status (formal/informal), industry and the region are provided in the household or labour force survey. As mentioned earlier, the sample is restricted to the age group 15-64 years and the variables are defined below:

- **Age:** Age of the individual
- **Gender:** Dummy variable, indicating female=1, 0 otherwise.
- **Marital status:** Dummy variable, indicating married=1, 0=single, and others includes living together, widowed, divorced.
- **Ethnic Group:** Ethnic groups for the various countries are the following: Brazil (E1: White, E2: Black, E3: Amarela, E4: Parda, E5: Indigenous); India (E1: Forward castes, E2: Scheduled tribes, E3: Scheduled castes, E4: Other Backward castes); and South Africa (E1: White, E2: African/Black, E3: Coloured, E4: Indian/Asian)
- **Region:** dummy variable, indicating urban=1, 0 otherwise. In the case of Mexico as rural urban categorisation is not available in the survey, we use the three geographical zone defined in the Mexico survey in place of urban areas.
- **Education:** We classify education into five categories: Illiterate, Literate, Primary, Secondary and Above Secondary. We generate four dummy variables for Illiterate, Literate, Primary, and Secondary and the reference category is "Above secondary".
- **Industry:** We aggregate the industries classified under NIC (National Industrial Classification) depending upon the country classification into six industry groups with similar qualitative characteristics: agriculture (comprises agriculture, forestry and fishing); manufacturing (comprises mining and manufacturing); electricity, gas and water; construction; low-skilled services sector (comprises trade, hotels and restaurant, transport and personal services) and high-skilled services sector (comprises banking and insurance, communication, real estate, business services and public administration). The categorization of the service sector into two groups is justified on the basis of skill and capital requirements. "Agriculture" is used as reference category and we constructed five dummy variables for each of the other industry groups.

- **Informal sector:** The variable informal sector is defined as the following: in Brazil, formal workers are those who have permanent contract and social security benefits, and informal workers are those who do not have then; in India formal workers are those who have atleast one of the social security benefits, otherwise they are classified as informal workers; in Indonesia formal workers are those who have permanent work, and workers in casual work and in agriculture are classified as informal workers; in Mexico the formal workers are defined as those with permanent contract and informal workers are those without such contracts; and in South Africa formal workers are those with regular contracts and social security benefits, and informal are those without it.

- **Minimum wages:** The legal information used for minimum wages relates to the analysis of the most recent labour legislation, such as labour codes, wage decrees, etc. We do not examine or analyse the judicial decision-making (jurisprudence), which may affect the interpretation of the legislation and, by extension, expand or diminish legal coverage. To assign a legal minimum wage to each worker in the data, we took the official minimum wages from the wage orders or sectoral wage determinations or the official decrees of the respective country. Every worker in the data set was assigned a legal minimum wage if the occupation or sector or industry in which the worker was employed had been legally covered by the official decree of the respective country. In the case of multiple minimum wages in a country, the minimum wage legislation provided information at the different levels. The assignment of a legal minimum wage to a worker was then based on a comparison of the occupational classification used in the household or labour force survey, and the categories in the minimum wage regulations. In most cases, it was not difficult to match the categories with the surveys and minimum wage legislations, as detailed information was available.

Table A.1: Construction of the wage variable for each country

Country	Wage variable	Unit of time	Log of hourly real wage
Brazil	wage	Daily base	$lhrwage = \ln(\frac{wage}{8 \times WDI})$
India	wgperday	Daily base	$lhrwage = \ln(\frac{wgperday}{8 \times WDI})$
Indonesia	wgperday	Daily base	$lhrwage = \ln(\frac{wgperday}{8 \times WDI})$
Mexico	wperday	Daily base	$lhrwage = \ln(\frac{wperday}{8 \times WDI})$
South Africa	wgperm	Monthly base	$lhrwage = \ln(\frac{wperday}{4.34 \times 45 \times WDI})$

Table A.2: Wage deflator used for each country

Country	WDI year1	WDI year2
Brazil	$WDI_{2005} = 1$	$WDI_{2009} = 1.20$
India	$WDI_{2004} = 0.96$	$WDI_{2009} = 1.36$
Indonesia	$WDI_{2005} = 1$	$WDI_{2009} = 1.38$
Mexico	$WDI_{2005} = 1$	$WDI_{2010} = 1.24$
South Africa	$WDI_{2007} = 1.12$	$WDI_{2011} = 1.47$

Note: The Wage Deflator Indices (WDI) are calculated by using the "inflation, consumer prices" from the World Bank website. The base year considered is 2005. http://databank.worldbar

$Quant_\theta(ln(w) \mid X) = \beta_0^\theta + \beta_1^\theta X + \beta_2^\theta \ln(\frac{wage - \text{minimum wage}}{wage})$

$Quant_\theta(ln(w) \mid X) = \beta_0^\theta + \beta_1^\theta X + \beta_2^\theta \ln(\text{Kaitz Index})$

Table A.3: Quantile wage regressions, India (including GDP)

	QR20	QR40	QR60	QR80
2004-5				
GDP	-0.01***	-0.01***	-0.005***	-0.004***
Effective minimum wage	0.32***	0.34***	0.36***	0.35***
Constant	2.70***	2.95***	3.11***	3.33***
Observations	34279	34279	34279	34279
Pseudo R^2	0.30	0.37	0.45	0.51
2009-10				
GDP	0.001	0.002***	0.002***	0.001*
Effective minimum wage	0.47***	0.46***	0.45***	0.41***
Constant	2.76***	3.38***	3.63***	3.88***
Observations	37949	37949	37949	37949
Pseudo R^2	0.29	0.38	0.47	0.51
Controls	Yes	Yes	Yes	Yes

Effective minimum wage is defined as the log of Kaitz index

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure A.1: Effects of minimum wages on wage distributions, India with GDP

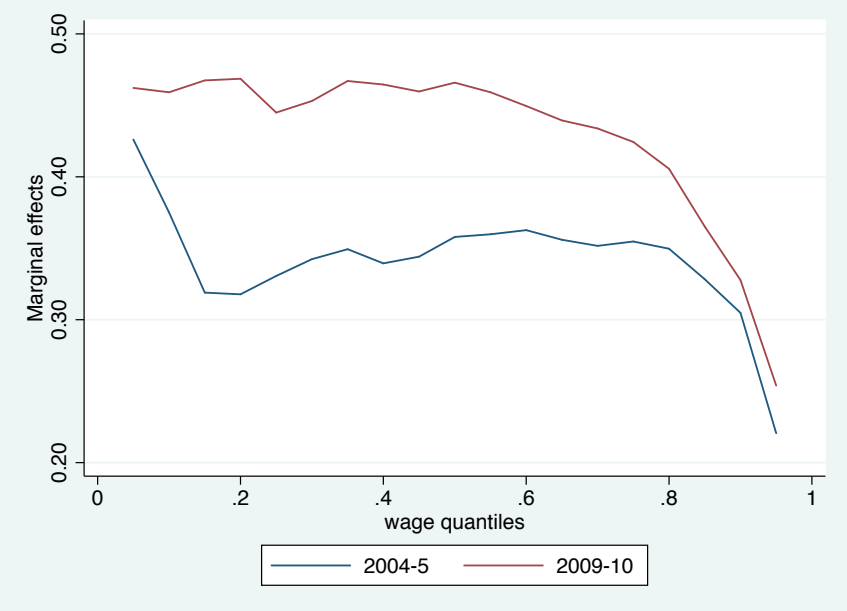


Table A.4: Quantile wage regressions, Brazil with minimum wage lags

	QR20	QR40	QR60	QR80
2005				
Lag of Effective minimum wage	0.14***	0.06**	-0.05**	-0.18***
Constant	3.26***	3.41***	3.52***	3.66***
Observations	116456	116456	116456	116456
Pseudo R^2	0.26	0.27	0.29	0.34
2009				
Lag of Effective minimum wage	0.42***	0.32***	0.25***	0.06***
Constant	4.25***	4.51***	4.83***	5.14***
Observations	122902	122902	122902	122902
Pseudo R^2	0.26	0.24	0.28	0.33
Controls	Yes	Yes	Yes	Yes

Effective minimum wage is defined as the log of Kaitz index

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure A.2: Effects of lagged minimum wages on wage distributions: Brazil

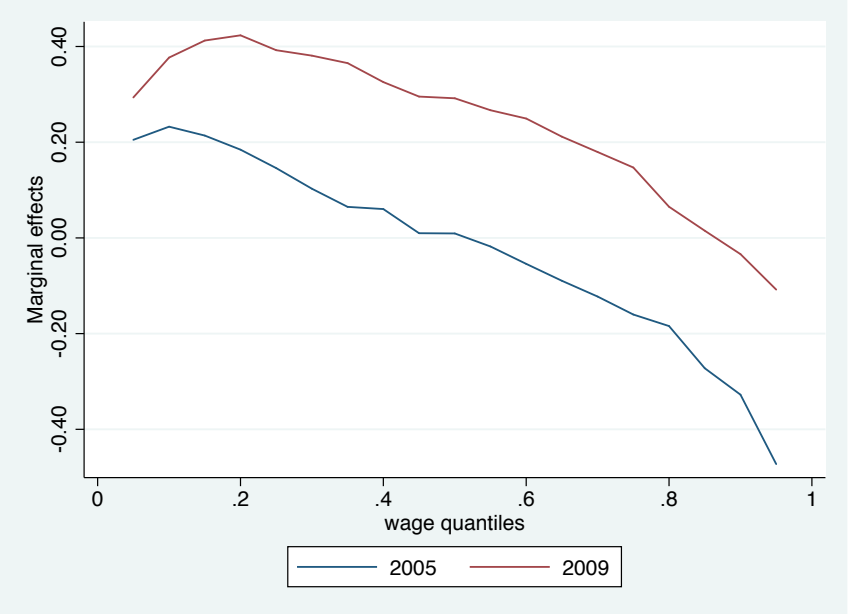


Figure A.3: Wage distributions and statutory minimum wages of covered employees: Across gender

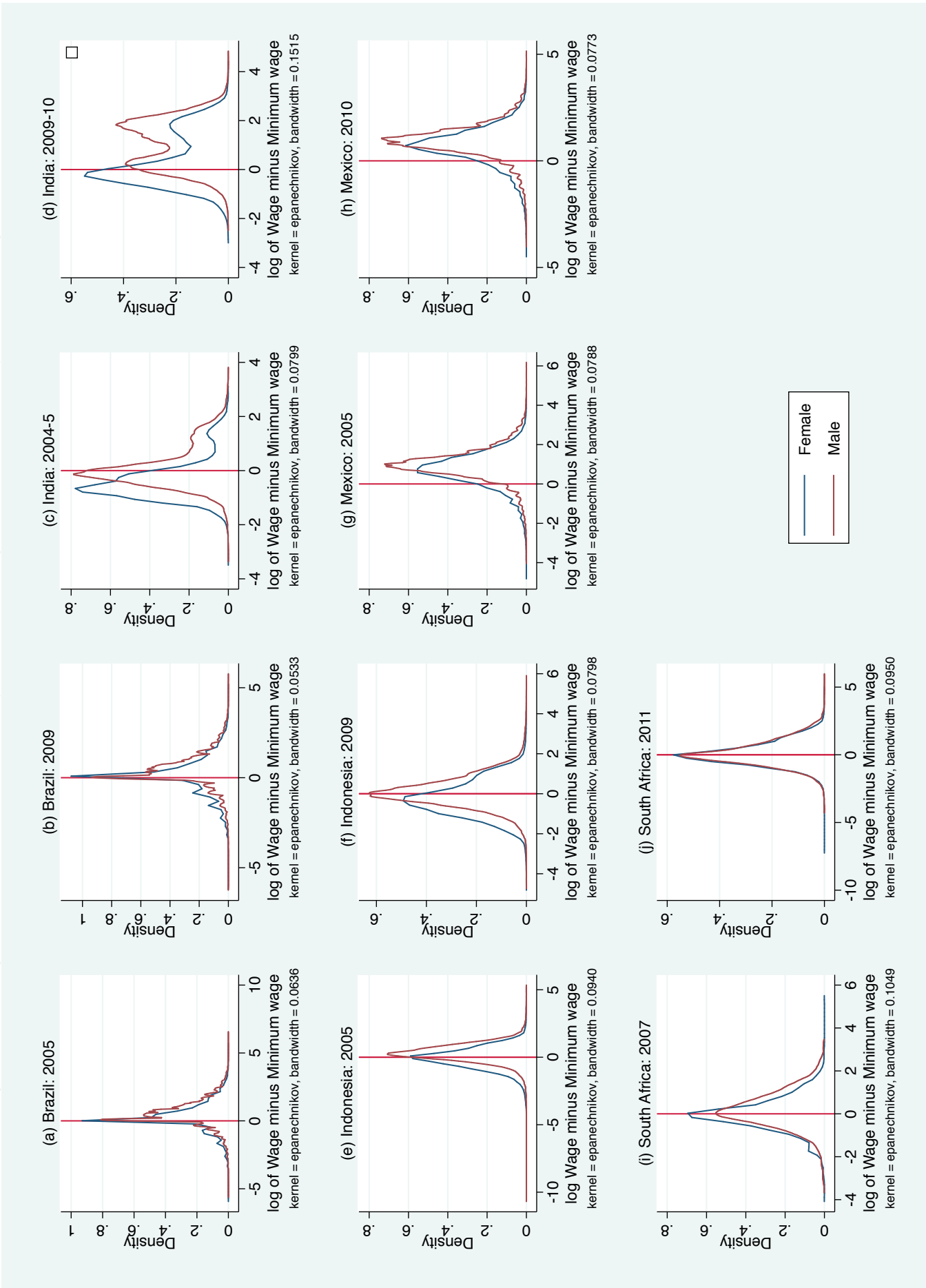


Figure A.4: Wage distributions and statutory minimum wages of covered employees: Across industry groups

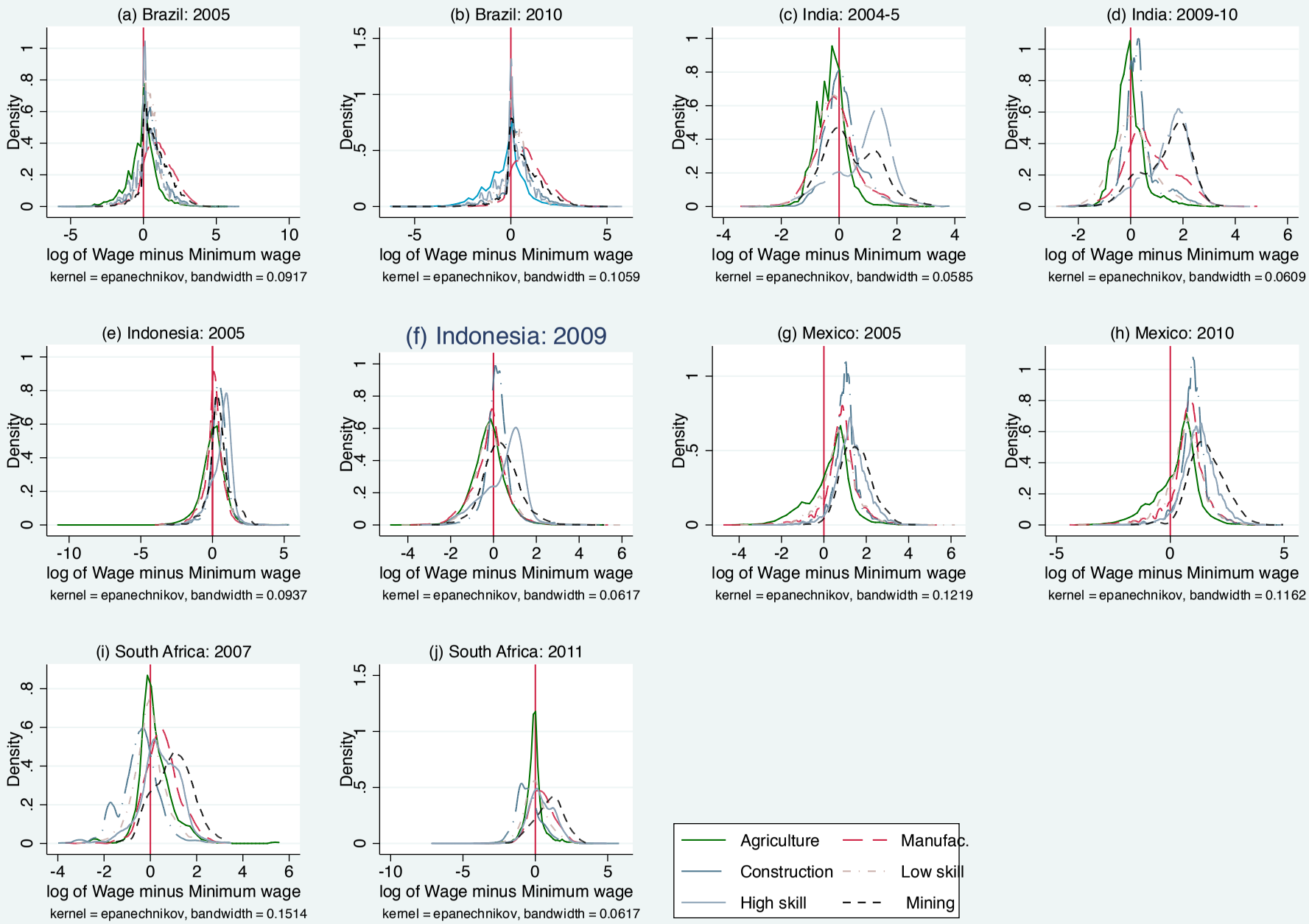
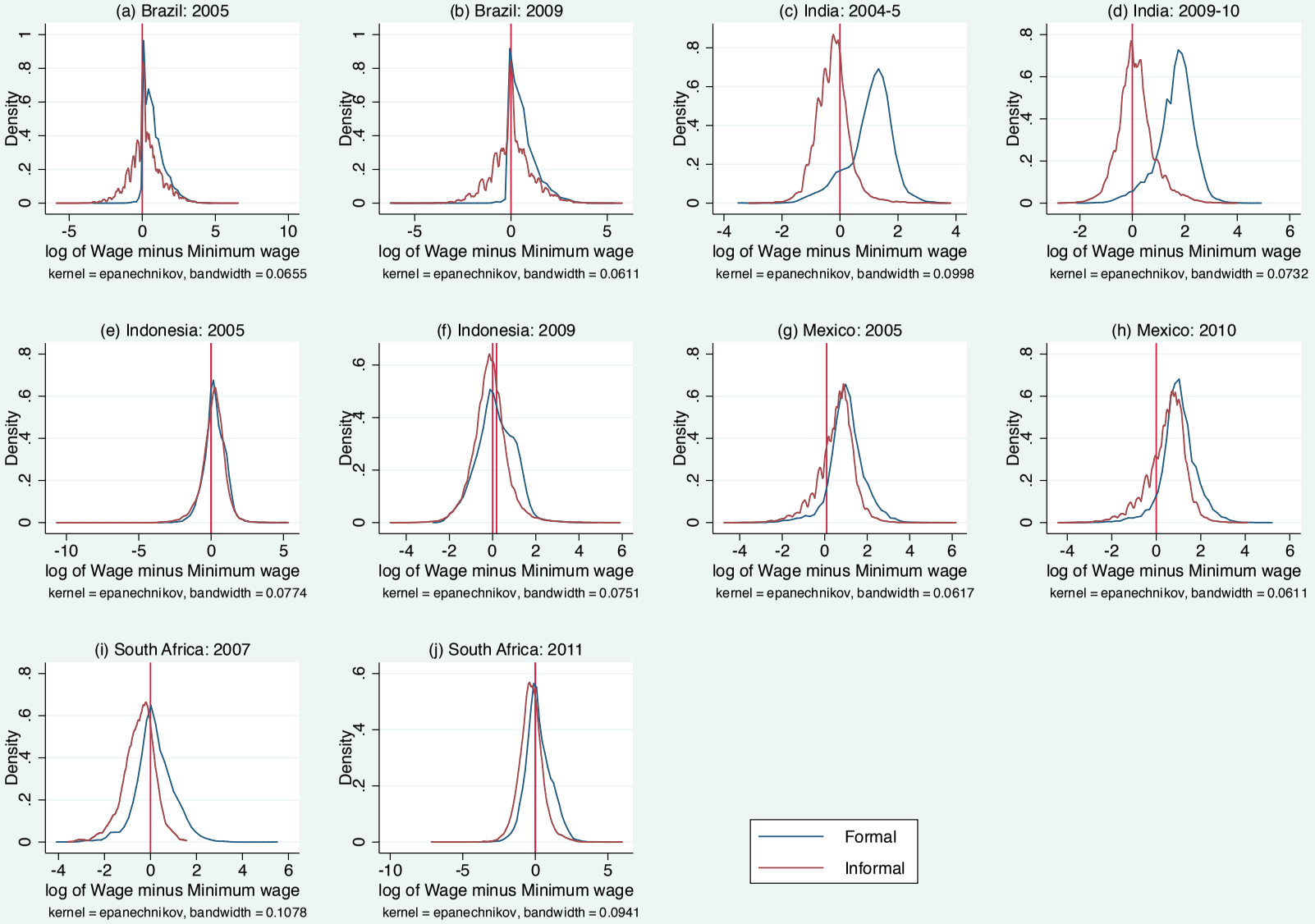


Figure A.5: Wage distributions and statutory minimum wages of covered employees: Across Formal-Informal



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