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Can Minimum Wages Close the Gender Wage Gap?

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Abstract

Using manufacturing plant-level census data, this paper demonstrates that minimum wage increases in Indonesia reduced gender wage gaps among production workers, with heterogeneous impacts by level of education and position of the firm in the wage distribution. Paradoxically, educated women appear to have benefitted the most, particularly in the lower half of the firm average earnings distribution. By contrast, women who did not complete primary education did not benefit on average, and even lost ground in the upper end of the earnings distribution. Minimum wage increases were thus associated with exacerbated gender pay gaps among the least educated, and reduced gender gaps among the best educated production workers. Unconditional quantile regression analysis attests to wage compression and lighthouse effects. Changes in relative employment prospects were limited.

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Can Minimum Wages Close the Gender Wage Gap?

Evidence from Indonesia

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1 Introduction

Can minimum wages reduce gender wage gaps? Using firm-level census data from Indonesia, this paper examines the impact of minimum wage changes on gender pay gaps among production workers in the manufacturing sector in Indonesia (1995-2006), as well as their impact on men's and women's relative employment prospects.[i] It examines heterogeneity in impact by level of education and position in the wage distribution.

While a large literature has documented gender pay discrimination (see Altonji and Blank, 1999; Blau, Ferber and Winkler, 2010; and Cain, 1986 for reviews) and examined the effects of minimum wages (see Neumark and Hellerstein, 2005 for a review), very few studies have focused on the impact of minimum wages on gender wage gaps and men's and women's relative employment prospects. The bulk of the literature on gender pay discrimination and minimum wages has relied on individual data, as they offer the valuable ability to control for individual characteristics that determine earnings.

This paper presents a complementary approach, examining how gender differences in wages and employment across employers respond to minimum wage changes using firm-level data. Such data enable one to control for employer characteristics and firm productivity, determinants of wages which are not usually measured well in worker-level data. Firm data also enable analysis of gender differences in employment impacts of changes in minimum wages *within* firms over time.[ii] Focusing on impacts on production workers, a relatively homogenous group of workers engaging in fairly similar (and rather routine) tasks, in a single sector, manufacturing, helps mitigate concerns that the documented impacts are driven by heterogeneity in impact across sectors and occupations.

Indonesia provides a compelling case to examine. Gender wage gaps are very large and minimum wages are set at the provincial level, with local schedules for when they are reset, so they vary both across provinces and over time (see Rama, 2001; World Bank, 2010). Figure 1 shows the extensive variation of minimum wages across provinces and over time, which facilitates identification.

Previewing the main findings, in aggregate, minimum wage increases are associated with reductions in gender pay gaps, but not with changes in relative employment prospects by gender. However, these aggregate relationships mask important heterogeneity in the impact of minimum wages by education and across the distribution of firm-level average production worker wages. While gender pay gaps are largest among production workers with the lowest levels of educational attainment, minimum wage increases were least effective in reducing gender pay gaps among this group. The wages of the least educated women did not rise in response to minimum wage increases, while those of uneducated men did, exacerbating gender pay gaps at the lower end of the education distribution. By contrast, minimum wage increases appear to have had the largest impact on women who complete junior high and high school; they experienced significant wage increases both in absolute terms and relative to men with the same education.

Quantile regressions that examine how minimum wages relate to gender pay gaps across the firm-level average wage distribution attest both to wage compression and lighthouse effects. Allowing the impact of minimum wages to vary by gender (but not yet by education), the results show that at the lower end of the average earnings distribution, minimum wages are associated both with the largest increase in average wages and with the starkest reduction in gender pay gaps, suggesting minimum wage increases and wage compression go hand-in-hand. Consistent with lighthouse effects, minimum wages were also associated with increases in wages in upper parts of the distribution, except at the very top.

The impacts of minimum wages on gender pay gaps across the firm-level average wage distribution also vary with educational attainment. The equalizing impact of minimum wages is strongest for better educated women at the lower end of the earnings distribution, while the inequality enhancing impact of minimum wages is strongest for the least educated women in the upper parts of the firm earnings distribution.

Evidence for impacts on minimum wages on women's relative employment prospects is limited; reductions in gender pay gaps have not come at the expense of relative reductions in women's employment opportunities. There is some evidence of substitution across skill categories, but the magnitudes are small and, moreover, very similar for men and women.

The remainder of the paper is organized as follows. The next section briefly reviews related literature and explains why the Indonesian manufacturing sector provides an interesting context to examine the impact of minimum wages. Section 3 presents the data and descriptive statistics. Section 4 discusses the empirical strategy. The main results are presented in section 5. Heterogeneity in impacts across the wage distribution is analyzed in section 6, which presents unconditional quantile regressions. The impact of minimum wages on men's and women's relative employment prospects is analyzed in section 7. A final section concludes.

2 Related Literature, Hypotheses, and Country Context

2.1 Related Literature

There is a considerable literature as to what explains (variation in) the gender gap in wages (see for instance the reviews by Cain, 1986, Altonji and Blank, 1999, Blau, Ferber and Winkler, 2010 or the meta-analyses by Stanley and Jarrell, 1998 and Jarrell and Stanley, 2004), much of it focused on the United States and West European countries. Three main explanations are discrimination, gender sorting across sectors and occupations offering different returns, and gender differences in human capital (education and in some cases, prior work experience too). A fourth determinant of gender pay gaps that has received little attention in this context are labor market institutions, or minimum wages, that could lower the extent of gender gaps by limiting the lower bound of wages workers receive. As more women tend to be at the lower end of the wage distribution, minimum wages, by disproportionately raising lower wages, could reduce the overall gender wage gap.

Explanations appealing to discrimination are either based on (i) 'discriminatory tastes' on the part of employers (or co-workers, customers etc.) who may simply prefer to have male workers (ii) 'statistical discrimination' or 'rational stereotyping' (Altonji and Pierret, 1997), or (iii) 'overcrowding' of women in traditional female occupations that lead to lower wages in these sectors or occupations (e.g. Bergmann 1974). The most prominent approach to test for labor market discrimination is to estimate Mincerian wage regressions at the level of individual workers. Discrimination is inferred from the residual differential in wages that remains "unexplained" after controlling for a wide array of proxies for productivity and other observable determinants of wages. This approach can be problematic in the presence of feedback loops between wages, hours, and occupational/sectoral selection (see e.g. Bielby and Baron, 1986). If there are desirable worker characteristics that are unobserved and for which women have a relatively lower supply, the residual would over-estimate discrimination. By contrast, if entry barriers keep women from entering certain jobs and demonstrating their (relatively equal) productivity, the residual could underestimate discrimination (see Blau and Kahn, 2006).

The sorting explanation for gender pay gaps is that women work in sectors and occupations that require less human capital and on-the-job training, and therefore earn lower wages (MacPherson and Hirsch, 1995; Blau and Kahn, 2006; Blau, Ferber and Winkler, 2010). Firm-level data can help control for gender sorting as they allow one to control for labor productivity and idiosyncrasies in employers' wage setting behavior (Neumark and Hellerstein, 2005). The few studies that use matched firm-level data sets to examine gender pay gaps have yielded mixed results; women in the United States have been shown to earn less than men relative to their productivity, while women in Israeli firms do not suffer pay discrimination (Hellerstein and Neumark, 1995, 1999; Bayard et al., 2003).

A third explanation for gender gaps in wages is that they reflect differences in human capital. To test this, measures of human capital are added to the Mincerian wage regressions (Mincer and Polachek, 1974), which consistently show women earning lower returns (Blau and Kahn, 2000). Part of the explanation is that women have received less education in the past.

Although not a driver of gender pay gaps per se, minimum wages can affect the extent of gender gaps in wages as they place a bound on how low wages can be set (Rubery, Grimshaw and Figueiredo, 2005; Dex, Sutherland and Joshi, 2000). Minimum wages are more likely to bind for women, who tend to earn lower wages. Consistent with this observation, DiNardo, Fortin and Lemieux (1996) use a semi parametric decomposition analysis and show that increasing wage inequality in the United States, especially for women, can be tied to declines in real minimum wages.

Minimum wages may also have *lighthouse effects* impacting the wages of those for whom they are not-binding, for example by serving a coordinating role in wage negotiations or because they have positive demand effects and act as a "big push" (Magruder, 2013) coordinating wage setting at a higher wage and employment equilibria. Studies of the impact on minimum wages in developing countries typically find evidence of both such effects and wage compression, with those at the bottom of the distribution gaining most (Gindling and Terrell, 2007; Lemos, 2009; Maloney and Nuñez-Mendez, 2004).[iii]

The employment effects of minimum wages, which critically depend on market structure, may also vary by gender (see Comola and de Mello, 2009). While the largest impacts are expected on the lowest paid workers, the empirical evidence on the employment impacts of minimum wages is mixed (see e.g. Neumark and Wascher, 2008, for a survey of the evidence).

2.2 Hypotheses

The studies discussed above suggest the following hypotheses. Minimum wages are likely to have the largest impact on those workers for whom they are binding. Consequently, one would expect workers with less human capital and women to experience the largest wage increases, with the least educated women benefitting the most. However, this result may not obtain if minimum wage changes have a "lighthouse effect" and induce all workers to demand wage increases commensurate with the change in minimum wages or if compliance with minimum wage changes is imperfect. One may also expect the workers that gain the most from minimum wage increases in terms of wage growth to bear a larger share of the brunt of employment adjustments made in response to minimum wage changes, as they are likely to become less attractive to employers since minimum wages render them more expensive both in absolute terms, and relative to workers whose wages did not increase as much.

2.3 Country Context

Indonesia provides a fruitful testing ground for the impact of minimum wages on gender wage gaps. To start with, there is a lot of variation in minimum wages, both across provinces and over time (recall Figure 1). The setting of minimum wages was done at the provincial level, on their own timetables and based on the local cost of a bundle of goods that would meet *Kebutuhan Hidup Minimum* (KHM) or 'minimum subsistence needs', largely composed of food and basic staples (Rama, 2001; World Bank, 2010). Changes in minimum wages were thus intended to reflect differences in the cost of living and changes therein across locations. Real minimum wages rose steadily through 1996, up until the final crisis, during which real wages fell dramatically as a result of rapid depreciation of the rupiah. With the crisis, Indonesia lost 13.5 percent of GDP and the exchange rate fell from approximately Rp 2,500 to the U.S. dollar to Rp 11,000 in early 1998. In the aftermath of the crisis, there was enormous political pressure both to further decentralize (many policy areas were given over to provincial and local governments in 2001) and to raise wages (see World Bank, 2010). Figure 1 shows how both of these factors served to raise minimum wages, particularly since 2001, but to varying extents across provinces, which aids identification.

While endogeneity between labor market conditions and minimum wages could be a concern, minimum wages in Indonesia were designed to be determined by basic consumption costs rather than local labor market conditions. Nonetheless, tighter labor market conditions could well contribute to bidding up local costs. Recall, however, that the focus of this paper is on gender gaps in labor market outcomes. A priori, it does not seem very likely that gender differences in either wages or employment drove overall minimum wage changes across provinces or over time.

Previous studies using Indonesian manufacturing census data (Harrison and Scorse, 2005; Alatas and Cameron, 2008) have documented a large amount of residual wage dispersion remains after workers' observable characteristics are accounted for. The impact of minimum wages is heterogeneous across firms, with large firms being more likely to comply with minimum wage legislation than small firms. These findings underscore the importance of controlling for employer characteristics. Overall, the minimum wage increases that occurred from the early to mid-nineties led to substantial increases in pay, but had rather limited employment impacts, at least in the short run.[iv] However, these studies have not assessed the extent to which minimum wage increases affect gender differences in earnings and employment prospects by level of education.

Nonetheless, there is some evidence that the impact of minimum wages varies by gender. Rama (2001), for example, focuses on the early 1990s and finds that women's average wages in manufacturing were more responsive to minimum wage changes than men's average wages using data from the national wages survey (Survey Upah) (see also World Bank, 2010 and Suryahadi et al., 2003).

3 Data and Descriptive Statistics

The Indonesian Annual Manufacturing Survey, the Statistiki Industri (SI) plant-level dataset contains information on all manufacturing plants with more than 20 employees[v] and has rich information on wages and employment for production and non-production workers, as well as on plant' productivity, ownership structure, export status, labor force composition, material inputs usage, and value-added. We primarily focus on the years 1995, 1996, 1997 and 2006 since in these years information on the educational attainment of the production workforce is available. To minimize the impact of pay differences associated with (unobservable) differences in occupation, we restrict our attention to production workers. By using a relatively homogenous group of workers in one specific sector we aim to minimize omitted variable bias that might yield spurious correlations between minimum wage increases and gender wage gaps. Following Amiti and Cameron (2007), Alatas and Cameron (2008), and Harrison and Scorse (2010), our measure for wages is derived by dividing the total wage bill for production workers by the number of production workers. The wage bill is not gender-disaggregated, so we follow Neumark and Hellerstein (1995, 1999) and focus on firm-level average wages as a function of the gender and education composition of the production workforce. See Appendix A for a discussion of the construction of other key explanatory variables.

Descriptive statistics are presented in Table 1 and show that male manufacturing production workers tend to be somewhat better educated than female ones and that minimum wages are very close to average wages.

4 Econometric Strategy

4.1 Impact on Gender Wage Gaps

To examine the impact of minimum wages on gender-wage gaps, firm-level analogues of Mincerian wage equations are estimated. These firm-level wage equations can be interpreted as the aggregation of individual Mincerian equations under the assumption that workers of the same gender earn the same wages (Neumark and Hellerstein, 1995). Our simplest specification models firm-level real average wages for production workers $\bar{w}_{i,t}$ in firm *i* at time *t* as a function of the gender composition of the production workforce;

(1) $$\ln(\bar{w}_{it}) = \boldsymbol{\beta_F}\textbf{Females} + \boldsymbol{u_i} + \boldsymbol{\varepsilon_{it}}$$

Where **Females** is a measure of the share of production workers who are women, $\boldsymbol{u_i}$ is an unobserved firm fixed effect and $\boldsymbol{\varepsilon_{it}}$ a zero mean random error term. Since the specification is estimated in log-linear form, we can interpret the coefficient $\boldsymbol{\beta_F}$ as a crude indicator of gender pay differences. For example if $\boldsymbol{\beta_F}$ is -0.02, then women would earn approximately 2% less than men.

To allow earnings to vary both by education and gender we estimate equations of the form:

(2) $$\ln(\bar{w}_{it}) = \boldsymbol{\beta_{PM}}\mathbf{PrimM_{it}} + \boldsymbol{\beta_{JM}}\mathbf{JunM_{it}} + \boldsymbol{\beta_{HM}}\mathbf{HighM_{it}} + \boldsymbol{\beta_{NF}}\mathbf{NoPrimF_{it}} + \boldsymbol{\beta_{PF}}\mathbf{PrimF_{it}} + \boldsymbol{\beta_{JF}}\mathbf{JunF_{it}} + \boldsymbol{\beta_{HF}}\mathbf{HighF_{it}} + \boldsymbol{u_i} + \boldsymbol{\varepsilon_{it}}$$

where $\mathbf{NoPrimF_{it}}$ refers to the share of production workers that are women that either did not complete primary school or did not attend school at all, $\mathbf{PrimF_{it}}$ ($\mathbf{PrimM_{it}}$) denotes the share of production workers whom are women (men) and for whom primary school was their highest level of educational attainment, $\mathbf{JunF_{it}}$ ($\mathbf{JunM_{it}}$), the proportion who are women (men) who dropped out after completing junior high (without completing high school), while $\mathbf{HighF_{it}}$ ($\mathbf{HighM_{it}}$) denotes the proportion of production workers who are women (men) with high school degree, a diploma, a Bachelors or a graduate degree. The omitted category is $\mathbf{NoPrimM_{it}}$ the share of production workers that are men that did not attend school or did not complete primary school.

The implicit assumption underlying these regressions is that workers of the same gender with the same education earn equal wages. If that is the case, the coefficient estimates $\boldsymbol{\beta_i}$ can be interpreted as percentage pay differentials between group *i* and the reference group, men without primary education. For example, if the coefficient $\boldsymbol{\beta_{JF}}$ is 0.10, this would imply that, ceteris paribus, female production workers with junior high school would earn approximately 10 percent more than male production workers without any primary education. This specification thus allows estimation of the returns to education and gender differences therein. Under the null of no gender differences in earnings by level of education $\boldsymbol{\beta_{NF} = 0}, \boldsymbol{\beta_{PM} = \beta_{PF}}$, $\boldsymbol{\beta_{JM} = \beta_{JF}}$, and $\boldsymbol{\beta_{HM} = \beta_{HF}}$.

To relax the assumption that all production workers within a unique set of demographic groupings (by education and gender) are paid the same wage we add controls for key firm characteristics, $\mathbf{X_{it}}$, including size, ownership, whether or not the firm exports, the ratio of

$$(3) \qquad \ln(\bar{w}_{it}) = \beta_{PM}\text{PrimM}_{it} + \beta_{JM}\text{JunM}_{it} + \beta_{HM}\text{HighM}_{it} + \beta_{NF}\text{NoF}_{it} + \beta_{PF}\text{PrimF}_{it} + \beta_{JF}\text{JunF}_{it} + \beta_{HF}\text{HighF}_{it} + \beta_X X_{it} + \beta_{P_j}\text{P} + \beta_S\text{S} + \beta_t\text{T} + \beta_{MW} lnMW + u_i + \varepsilon_{it}$$

production workers to total employees (the "unskilled ratio") and value-added per worker as a proxy for productivity. In addition we include sector, $\boldsymbol{S}$, province, $\boldsymbol{P}$, and time dummies, $\boldsymbol{T}$. To assess the impact of minimum wages, we include a measure of real minimum wages, $\boldsymbol{lnMW}$ (see Appendix A for variable definitions).

This specification estimates the average impact of minimum wages on production workers' wages. To assess whether and how the impact of minimum wages varies by gender and education, we interact our measures of the composition of the production workforce with the demeaned real provincial minimum-wage level, $\boldsymbol{\widetilde{lnMW}_{jt}}$.[vi] Our most general specification is:

$$(4) \qquad \ln(\bar{w}_{it}) = \beta_{PM}\text{PrimM}_{it} + \beta_{JM}\text{JunM}_{it} + \beta_{HM}\text{HighM}_{it} + \beta_{NF}\text{NoF}_{it} + \beta_{PF}\text{PrimF}_{it} + \beta_{JF}\text{JunF}_{it} + \beta_{HF}\text{HighF}_{it} + \beta_{MNM}\widetilde{lnMW}_{jt}\text{NoM}_{it} + \beta_{MPM}\widetilde{lnMW}_{jt}\text{PrimM}_{it} + \beta_{MJM}\widetilde{lnMW}_{jt}\text{JunM}_{it} + \beta_{MHM}\widetilde{lnMW}_{jt}\text{HighM}_{it} + \beta_{MNF}\widetilde{lnMW}_{jt}\text{NoF}_{it} + \beta_{MPF}\widetilde{lnMW}_{jt}\text{PrimF}_{it}$$

$$+\boldsymbol{\beta_{MJF}}\widetilde{\boldsymbol{lnMW}}_{jt}\mathbf{JunF_{it}} + \boldsymbol{\beta_{MHF}}\widetilde{\boldsymbol{lnMW}}_{jt}\mathbf{HighF_{it}}$$
$$+\boldsymbol{\beta_X X_{it}} + \boldsymbol{\beta_{P_j}}\mathbf{P} + \boldsymbol{\beta_S}\mathbf{S} + \boldsymbol{\beta_t}\mathbf{T} + \boldsymbol{u_i} + \boldsymbol{\varepsilon_{it}}$$

The coefficients $\boldsymbol{\beta_{Mi}}$ indicate how much production workers in group i benefit from minimum wage increases. We examine whether the impact of minimum wages varies by gender and education. In particular, we test the nested null hypotheses that the impact of minimum wages is homogenous ($\boldsymbol{\beta_{MNM}} = \boldsymbol{\beta_{MPM}} = \boldsymbol{\beta_{MJM}} = \boldsymbol{\beta_{MHM}} = \boldsymbol{\beta_{MNF}} = \boldsymbol{\beta_{MPF}} = \boldsymbol{\beta_{MJF}} = \boldsymbol{\beta_{MHF}}$) and the less restrictive hypothesis that the impact of minimum wages varies by level of education but not by gender ($\boldsymbol{\beta_{MNM}} = \boldsymbol{\beta_{MNF}}, \boldsymbol{\beta_{MPM}} = \boldsymbol{\beta M_{MPF}}.\ \boldsymbol{\beta M_{MJM}} = \boldsymbol{\beta_{MJF}}.$ and $\boldsymbol{\beta_{MHM}} = \boldsymbol{\beta_{MHF}}$).

Inclusion of province dummies ensures variation in minimum wages is identified by means of temporal variation of the minimum wage within provinces. Moreover, our preferred specifications condition on firm fixed effects $\boldsymbol{u_i}$. This reduces selection bias associated with sorting and eliminates the role of time-invariant unobservables.[vii] In addition, we account for time varying fluctuations in firm-productivity, proxied by real value added per worker, and other firm characteristics that may impact wages, though it should be noted that both productivity and other control variables are potentially endogenous.[viii] For example, one might expect that policymakers that anticipate positive productivity growth (or shocks) would increase minimum wages. We nonetheless include such variables in order to minimize omitted variable bias.

These firm-level estimates enable us to retrieve estimates of the *average* impact of minimum wages. Such average impacts may mask substantial heterogeneity in impact across the wage distribution, as already alluded to in section 2. To check the robustness of our results and to assess how the impact of minimum wages varies across the minimum wage distribution, we also estimate unconditional quantile regression models using the re-centered influence function approach (RIF) laid out in Firpo et al. (2009). This approach seeks to identify the marginal effects of covariates on unconditional quantiles of the wage distribution by means of a two-step procedure. This is done by estimating the RIF function for a particular quantile of firm-level wages and using that as the left-hand side variable on the set of firm-level covariates discussed above.[ix] The first stage obtains estimates of the re-centered influence function (RIF), for the τ^{th} quantile of interest, q_τ, using kernel density estimation. In the second stage, these estimates are in turn regressed on firm-level covariates using least squares fixed effects regression. The resulting coefficient estimates (on the minimum wage) can be interpreted as the expected effect of a change in the relevant covariate (say the minimum wage) at the quantile in question.[x] Estimating effects on unconditional quantiles helps to assess whether, and if so, how the impact of minimum wages varies across the wage distribution.[xi] Further details on the mechanics and underlying econometric assumptions of RIF regression can be found in Appendix B.

4.2 Impact on Men's and Women's Relative Employment Effects

Having examined the impact of minimum wages on gender pay gaps, we then examine their impact on women's relative employment prospects. The focus is on *relative* rather than absolute employment impacts since we are interested in assessing potential tradeoffs between the impact of minimum wages on gender pay gaps and women's relative employment prospects. Moreover, previous studies (Rama, 2001; Alatas and Cameron, 2008; Harrison and Scorse, 2010), have shown that minimum wage increases in Indonesia have historically had limited but heterogeneous employment impacts, with small firms (which are paying lower wages) typically adjusting employment more than large firms.

To assess the impact of minimum wages on women's relative employment opportunities, we regress the share of female production workers on minimum wages and a host of firm characteristics, $\boldsymbol{X_{it}}$, and sector, $\boldsymbol{S}$, province, $\mathbf{P}$ and time dummies $\mathbf{T}$:

$$(5) \qquad \%\boldsymbol{Females_{it}} = \boldsymbol{\beta_{MW} lnMW + \beta_X X_{it} + \beta_{P_j}}\mathbf{P} + \boldsymbol{\beta_S}\mathbf{S} + \boldsymbol{\beta_t}\mathbf{T} + \boldsymbol{u_i + \varepsilon_{it}}$$

Where $\boldsymbol{u_i}$ is an unobserved firm fixed effect and $\boldsymbol{\varepsilon_{it}}$ is a random error term. Again, we estimate this regression both using OLS and Fixed Effects methods, with the latter being our preferred estimation method. The coefficient on minimum wages, $\boldsymbol{\beta_{MW}}$ enables us to assess whether minimum wages are associated with especially (dis)advantageous employment opportunities for women. The regression also helps us document what type of firms women sort into.

To assess how the impact on employment varies by gender and education, we also estimate versions of equation (1) in which we use as dependent variable respectively the proportion of production workers who are women and men in each of the education categories. These regressions enable us to examine whether minimum wage increases are associated with improved employment prospects for educated workers and how this relationship might vary by gender.

5 Impact of Minimum Wages on Gender Pay Gaps

5.1 Main Results

Table 2 presents our baseline regressions of the relationship between minimum wages and gender pay gaps among production workers. The first two columns present results controlling for province and year fixed effects and the gender composition of the production workforce. The coefficients indicate the extent of gender pay gaps controlling for location and time only. The second specification, presented in columns 3 and 4, regresses firm-level real average wages for production workers on province- and year dummies, minimum wages, the gender composition of the production workforce and their interaction. The third specification, presented in columns 5 and 6, includes additional controls for ownership structure, firm age, size, the occupational composition of the firm, whether or not a firm-exports, productivity proxied by the log of value added per worker, sector- and year dummies, and interactions between variables measuring the composition of the production workforce and minimum wages. The fourth specification, presented in columns 7 and 8, adds controls for the educational composition of the production workforce and which are only available for 1994-1997 and 2006. All specifications are estimated by both OLS and fixed effects, with the latter being our preferred estimation methodology.

Table 2 makes three points clearly. The first is the extent of gender wage gaps in Indonesia. When controlling for time and location only (specification 1), a one percentage point increase in the share of female production workers is associated with a 0.56 percentage point decrease in wages in the OLS specification and a 0.21 percentage point decrease in overall wages when controlling for firm fixed effects.[xii] These effects are large, but not out of line with earlier firm-level studies of the gender pay gap. For instance, Hellerstein and Neumark (1999) document a gender pay gap of around 24% in Israel, while Bayard et al. (2003) document gaps between 33% and 38% in the United States, which drop to roughly 19% when industry and occupation controls are added. The gender pay gap remains statistically significant as additional firm controls are included (specifications 2-4), but shrinks somewhat. That controlling for firm characteristics and firm fixed effects diminishes gender pay gaps attests to sorting being part of the explanation for women's lower earnings (note that such sorting may itself be driven by discrimination if, for example, better paying firm are less likely to hire women). Second, minimum wages are consistently associated with significantly higher wages. Third and of focal interest, this effect of minimum wages raising wages is consistently significantly higher in firms that employ more women; minimum wages are thus associated with significant reductions in the gender wage gap. Importantly, the results regarding the impact of minimum wages and their differential impact on firms employing more women are robust to inclusion of the educational composition of the production workforce.[xiii] In summary, Table 2 shows higher minimum wages are associated with higher wages, especially for women.

It is furthermore comforting that the results on other coefficients presented here are consistent with those found in the literature; older firms, foreign-owned firms and exporters pay higher wages, while wages are negatively correlated with the "unskilled ratio", defined as the proportion of the labor force that are production workers. In addition, the returns to education are positive (see columns 7 and 8) and increasing in our preferred Fixed Effects specification.

5.2 Gender Differences by Level of Education

The results presented in Table 2 did not allow the impact of minimum wages on gender pay gaps to vary by education. Table 3 presents results of models that relax this restriction. The baseline specification presented in columns 1 and 2 regresses firm-level real average wages on province- and year dummies and variables that characterize the gender and education composition of the production workforce. The second specification includes additional controls for ownership structure, firm age, size, the occupational composition of the firm, whether or not a firm-exports, productivity, sector- and year dummies. The final and preferred specification is presented in columns 5 and 6 and allows for interactions between variables measuring the composition of the production workforce and minimum wages, thus allowing the impact on the gender gap to vary by level of education.

The coefficient estimates presented in column 1 can be interpreted as average gender pay differences by level of education net of province- and time-effects. The implied gender wage gap, presented in Table 4, initially diminishes with the level of education, although it widens again for those who attended high school.

These high gender premia are in part driven by sorting. When one controls for firm fixed effects (column 2), the estimated gender pay gaps become much narrower suggesting men sort into firms that pay higher wages. Such sorting could reflect discrimination against hiring women in higher paying sectors/firms. Controlling for firm characteristics, as is done in specification 2, further diminishes the gap. Gender pay differences are the product of differences in pay both within and across firms.

The results presented in columns 3 and 4 furthermore suggest that the average impact of a 1 percentage point increase in minimum wages would be to raise production workers' wages by approximately 0.1-0.2 percentage points. This effect is statistically significant at the 1 per cent significance level, and in line with estimates of the impact of minimum wage changes obtained in other developing countries (see e.g. Cunningham, 2007, Lemos, 2009, Gindling and Terrell, 2009).

Columns 5 and 6 unveil that the impact of minimum wages varies by gender and with educational attainment; the null hypotheses that the impact of minimum wages is homogeneous and that their impact varies by level of education but not by gender are both strongly rejected. According to our preferred fixed effects estimates presented in column 6, the extent to which women benefit from minimum wage increases is positively correlated with educational attainment. Whereas women lacking primary education do not benefit from minimum wage increases, educated women do. The biggest beneficiaries of minimum wage increases are women who have completed at least junior high school; both women who completed junior high and those who completed high school or higher degrees enjoy substantial and significant wage gains.

For men, no such pattern is detected; according to the OLS estimates in column 5, the biggest beneficiaries among men are those lacking primary education. Men whose highest level of educational attainment is primary school also enjoy significant (though lower) wage gains, as do those who completed at least high school.[xiv] However, in our preferred fixed effects specifications presented in column 6, male wage premia associated with minimum wage increases are much lower, and, moreover, not statistically significant at the conventional 5% significance level. The one exception is among the most educated men, but the increase they enjoy is much less than the increase experienced by women in the same education category. As a consequence, minimum wage changes are associated with a significant reduction in gender pay gaps among workers who completed at least junior high school, but exacerbated compensation differentials among those lacking primary education, for whom the average gender pay gap was the largest to start with. To see this, look at column 6 of the top panel of Table 4, which presents the impact of minimum wages on minimum wage gaps.

6 Does the Impact of Minimum Wages Vary Across the Wage Distribution?

Thus far, we have examined the impact of minimum wages on average earnings premia. Yet, the literature reviewed in section 2 suggests the impact of minimum wages is likely to vary considerably across the wage distribution. As a further robustness test and to assess how the impact of minimum wage changes across the wage distribution, we estimate unconditional quantiles regression following Firpo, Fortin and Lemieux (2009) (hereafter FFL), which put stringent demands on the data. We present estimates of two different models.[xv] The first model, presented in Table 5, allows the impact of the minimum wage to vary by gender but not by education, while the second, presented in Table 6, allows for heterogeneity in impact by both gender and education. Both models include a full set of firm controls. Recall that quantiles are based on firm-level average earnings for production workers. It is worth noting that across the sample, the minimum wage on average falls at the 38th percentile of the average wage distribution, fluctuating between the 23rd and the 55th percentile across provinces and over the sample period.

Table 5 contains several noteworthy results. To start with, the gender pay gap is present and consistently significant across the wage distribution, except at the top end of the firm earnings distribution (the 90th percentile, presented in column 5). Second, minimum wages are associated with significantly higher wages, except again at the top end of the average wage distribution. Third, this effect is even stronger for firms employing proportionately more women; the interaction of minimum wages and the share of women production workers is highest at the bottom of the wage distribution. At the 10th percentile, a 1 percentage point increase in minimum wages is associated with a reduction in the gender wage gap of 0.5 percentage points whereas at the median, the associated reduction is 0.3 percentage points. By contrast, at the top end of the minimum wage distribution, the interaction between minimum wages and the share of female workers is significantly negative. Minimum wage increases are thus associated with a compression of earnings at the bottom of the distribution, as well as with lighthouse effects, as they also impact wage setting of firms in the upper parts of the wage distribution, though impacts are less pronounced at the very top end of the distribution.

Table 6 presents the results of models which allow the impact of minimum wages on the gender wage gap to vary with education. The results are summarized in Table 7, and unveil that both the gender wage gap and the association between minimum wages and the gender pay gap vary with the level of educational attainment as well as across the wage distribution in non-monotonic fashion. The gender pay gap is largest among the least educated workers at the bottom end of the wage distribution.

The impact of minimum wages also varies across the distribution; minimum wage increases have the biggest positive impact on women lacking primary education at the bottom of the earnings distribution, yet are associated with significantly negative premia for such women in upper parts of the earnings distribution. Similarly, positive impacts on the earnings of better educated women are more prevalent in lower echelons of the earnings distribution. At the very top end of the distribution, women don't benefit from minimum wage increases. For men, by contrast, the impact of minimum wages is much less consistent, and most often statistically insignificant. As a result, the equalizing impact of minimum wages on gender pay gaps, documented in Panel B (of Table 7), is most pronounced in lower parts of the earnings distribution and among better educated workers. By contrast, inequality enhancing impacts of minimum wage increases on the gender pay gap appear to be confined to less educated workers in the upper parts of the earnings distribution.

Thus the findings present a more nuanced story, where firms in the lower part of the distribution raise their wages in the face of rising minimum wages – and particularly so for educated women. These women are paid considerably less than men with the same education. One possible explanation for these findings is that such women are paid low wages relative to their productivity; from the firms perspective they constitute a source of surplus and raising their wages is feasible. Accordingly these are the workers whose bargaining power should be the highest. However the least educated may not have the same bargaining power and wage increases may outstrip their productivity. Firms at the upper end of the wage distribution may already be paying above the minimum wage. Particularly in firms paying above average wages, the evidence shows little appetite for raising the least educated women wages.

7 Do Minimum Wages Impact Relative Employment Prospects?

To examine the impacts of minimum wages on men's and women's relative employment prospects, we regress indicators of the composition of the production workforce on minimum wages and a host of firm characteristics. Our baseline results are presented in Table 8, which regresses the share of women in the production workforce on minimum wages. The first specification only includes controls for minimum wages, year and province dummies. The second specification includes additional controls for firm size, the unskilled ratio, whether or not the firm exports, firm age, value-added per worker as well as foreign and government ownership and sector-dummies. Again, (some of) these variables may well be endogenous, but they are included to minimize omitted variable bias. The third specification adds controls for the average educational attainment of the production workforce (though not disaggregated by gender). Since such controls are only available for 1994-1995, 1996, 1997 and 2006 by necessity the sample is restricted to those years in the final specification. All specifications are estimated using both OLS and Fixed Effects methods.

The results again reinforce the importance of controlling for firm characteristics. When no firm characteristics are controlled for (column 1, specification 1), the share of women is negatively correlated with minimum wages, albeit that the estimated coefficient is small; a 1 percentage point increase in minimum wages is associated with a reduction of the proportion of women of 0.02 percentage points. However, once firm fixed effects are accounted for, as is done in column 2, the association between minimum wages and the share of women in the production workforce becomes positive and significant at the 10% level, suggesting that for a given firm increases in minimum wages are, if anything, associated with marginally better relative employment prospects for women. The effect is very small however. The explanatory power of specifications that only control for minimum wages is weak, as is evidenced by the low R^2s. Adding additional firm controls, as is done in columns 3 and 4, does not affect these coefficient estimates on the minimum wage very much, yet substantially improves the explanatory power of the model, with the R^2 rising to 0.34 in the OLS specification.[xvi]

When educational attainment is controlled for, as is done in columns 5 and 6, minimum wages are significantly positively associated with the share of women in the production workforce in the OLS specification (column 5). Our preferred fixed effects specification (presented in column 6), does not reject the null hypothesis of no association between minimum wages and women's relative employment prospects. To summarize, in aggregate, women's relative employment prospects are not strongly correlated with minimum wages.

To assess how minimum wages affect the employment opportunities of workers with different skill levels and how this might vary by gender, we run regressions in which we use as dependent variables the share of women (men) in the production workforce with a given level of educational attainment. The results are presented in Table 9 and present two different specifications, both using OLS as well as Fixed Effects estimation. The first specification, presented in the top Panel (A) only controls for minimum wages, year, and province dummies. The second specification, presented in the bottom panel (B) includes a full set of firm controls, including firm age, whether or not the firm exports, the ratio of unskilled workers, foreign ownership, government ownership, log firm size and log output per worker.

Turning to the results, in our preferred fixed effects specifications minimum wages are negatively correlated with the share of production workers who completed junior high school, both for men and women, but positively correlated with the share of workers completing primary school. Although the estimated coefficient estimates are modest, these findings are consistent with firms substituting more educated workers for less educated workers. Why this is happening is not clear as one might expect firms to hire more skilled workers when forced to pay higher wages. The fact that such substitution happens among both men and women, suggests these patterns are not driven by gender-specific tradeoffs. Importantly, our results are at odds with the notion that minimum wage increases adversely impact women's relative employment prospects.

8 Conclusion

The paper adds to the literature on the gender effects of minimum wages by looking at how different firms adjust their wages and the composition of employment within the firm in response to minimum wage changes. Using manufacturing firm-level census data, this paper demonstrates sizeable gender wage gaps among production workers. These gender pay differentials are to a large extent driven by sorting across firms and by differences in firm productivity, but persist even after firm characteristics and differences in value-added per worker are accounted for. They are also robust to controlling for firm fixed-effects. Thus gender pay differences are driven by differences in pay across as well as within firms.

Gender differences in the impact of minimum wage increases on wages are strongly correlated with educational attainment. Women with the least education did not benefit from increased minimum wages on average, whereas women higher in the education distribution (i.e those who completed at least junior high school) benefitted the most. Average gender wage gaps among the least educated production workers were exacerbated, while gaps between the best educated production workers diminished.

Quantile regressions, which serve as a robustness check, attest both to wage compression, as well as lighthouse effects of minimum wages. The dis-equalizing impact of minimum wages on gender pay gaps among the least educated is most pronounced in the upper part of the distribution of firm-level average wages, while the equalizing impact is strongest in the bottom half of the distribution among the better educated production workers.

The impact of minimum wages on men's and women's relative employment prospects appears to be rather limited, and reductions in the gender pay gap do not seem to have come at the expense of large losses in women's labor market opportunities.

The results presented in this paper highlight the importance of controlling for employer characteristics when examining gender pay differentials and policies to alleviate them. More generally, they underscore the need to be cognizant of heterogeneity in impact both across firms and workers when designing policies to redress gender inequities in the labor market.

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9 Figure and Tables

Figure 1: Minimum wages across provinces, 1991-2006

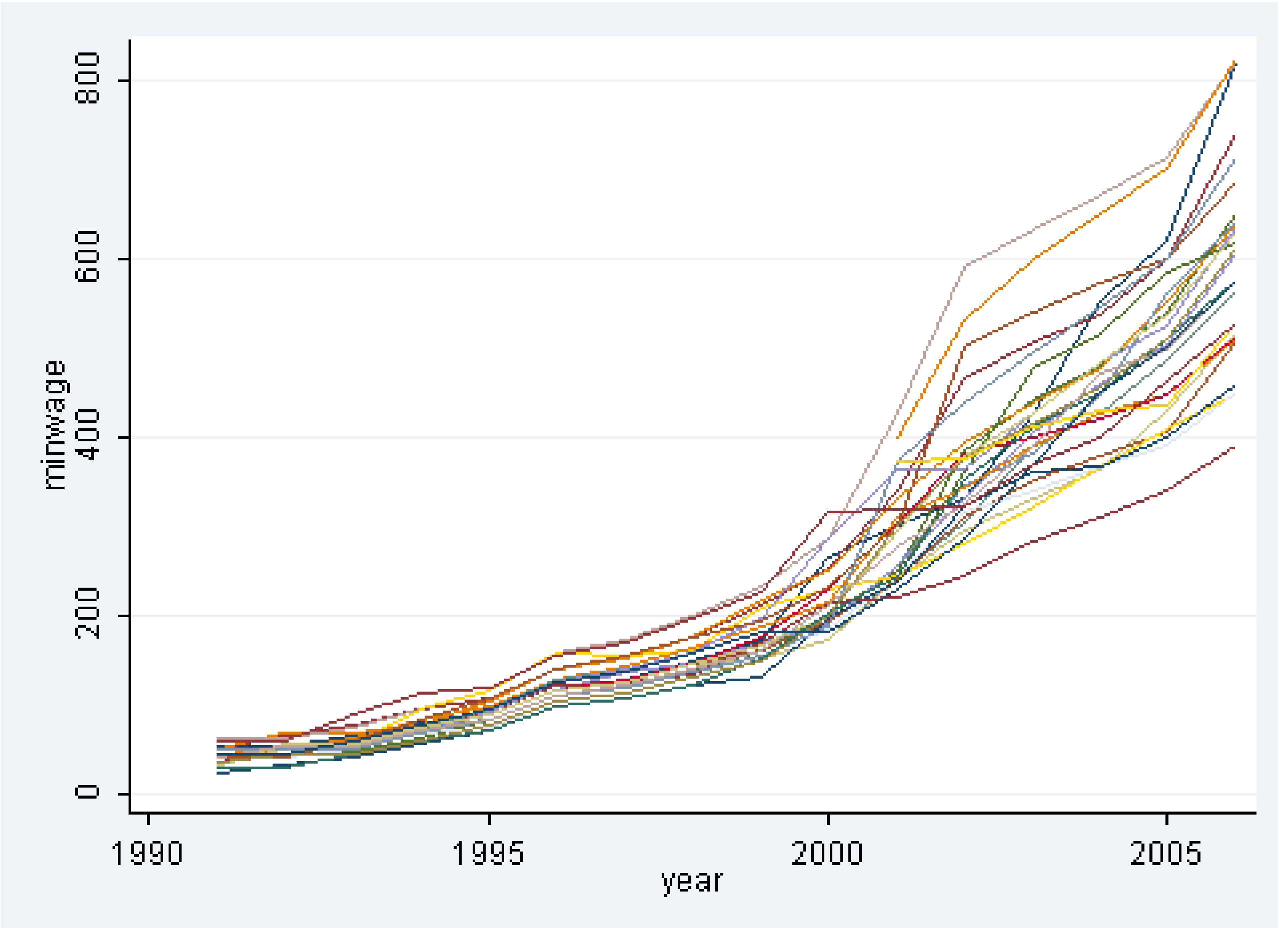

Table 1: Descriptive Statistics Firms – SI data

	Mean	Std. Dev.	**N**
1993-2006 (N=273,444)			
Log Wages (Firm-Level Average, '000s Real Rupiah)	7.070	0.810	273,444
Log Minimum Wage ('000s Real Rupiah)	6.980	0.270	273,444
L	157.980	380.450	273,444
Log L	4.140	1.140	273,444
Foreign-owned	0.070	0.250	273,444
Government-owned	0.030	0.160	273,444
Exporter	0.150	0.360	273,444
Log Firm Age	2.330	0.860	272,765
Unskilled Ratio	0.850	0.150	273,444
Log V/L (Real Rupiahs)	8.100	1.230	272,966
1994-1997, 2006 only			
%No Primary-Men (Did not complete primary school)	0.040	0.110	87,939
%No Primary-Women (Did not complete primary school)	0.200	0.240	87,939
%High-Men (Completed high school)	0.170	0.180	87,939
%High-Women (Completed high school)	0.200	0.260	87,939
%Junior-Men (Completed junior high school)	0.040	0.110	87,939
%Junior-Women (Completed junior high school)	0.160	0.220	87,939
%High +-Men (Completed high school – and/or a higher degree)	0.110	0.160	87,939
%High +-Women (Completed high school – and/or a higher degree)	0.080	0.150	87,939

Table 2: Firm-level Earnings Regressions: Entire Sample (1993-2006)

	Dependent variable: log firm-level average wages							
	OLS ('93-'06)	FE ('93-'06)	OLS ('93-'06)	FE ('93-'06)	OLS ('93-'06)	FE ('93-'06)	OLS ('95-'97 '06)	FE ('95-'97 '06)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
% Female	-0.569***	-0.209***	-0.534***	-0.203***	-0.131***	-0.121***	-0.168***	-0.181***
	(0.010)	(0.015)	(0.009)	(0.015)	(0.007)	(0.014)	(0.009)	(0.025)
Log Minimum Wage			0.305***	0.069***	0.070***	0.040**	0.091***	0.130***
			(0.022)	(0.020)	(0.017)	(0.018)	(0.032)	(0.044)
Log Min.Wage*			0.097***	0.086***	0.143***	0.129***	0.134***	0.094***
*%Female			(0.018)	(0.017)	(0.014)	(0.016)	(0.022)	(0.031)
Foreign-owned					0.002	-0.005	0.030**	0.008
					(0.010)	(0.013)	(0.013)	(0.024)
Government-owned					-0.040***	0.011	-0.019	0.023
					(0.014)	(0.011)	(0.018)	(0.026)
Exporter					-0.001	0.004	-0.006	0.009
					(0.005)	(0.005)	(0.007)	(0.009)
Log Firm Age					0.017***	0.072***	0.031***	0.091***
					(0.002)	(0.006)	(0.003)	(0.011)
Log L					0.033***	0.003	0.015***	-0.017*
					(0.002)	(0.005)	(0.003)	(0.009)
Unskilled ratio					-0.415***	-0.568***	-0.335***	-0.539***
					(0.015)	(0.019)	(0.019)	(0.033)
Log V/L					0.315***	0.241***	0.292***	0.233***
					(0.003)	(0.003)	(0.004)	(0.005)
% Primary							0.134***	0.019
							(0.016)	(0.021)
% Junior							0.283***	0.099***
							(0.015)	(0.023)
% High+							0.278***	0.220***
							(0.016)	(0.025)
Province Dummies	X		X		X		X	
Industry Dummies					X		X	
Year Dummies	X	X	X	X	X	X	X	X
N	273,444	273,444	273,444	273,444	272,289	272,289	87,785	87,785
R^2	0.210	0.097	0.212	0.097	0.525	0.210	0.513	0.232

Note: *** p<0.01,** p<0.05, * p<0.1. Standard errors, reported in parentheses, are heteroscedasticity robust and clustered by establishment. Minimum wages, wages and value-added are all measured in real terms. Minimum wage and share of female workers are demeaned.

Table 3: Firm-level Earnings Regressions: By Education (1994-1997 and 2006)

	OLS (1)	FE (2)	OLS (3)	FE (4)	OLS (5)	FE (6)
Dependent variable: log firm-level average wages						
% No Primary-Women	-0.808***	-0.328***	-0.255***	-0.222***	-0.267***	-0.250***
	(0.049)	(0.063)	(0.038)	(0.056)	(0.040)	(0.058)
% Primary-Men	0.202***	0.023	0.110***	0.003	0.099***	-0.0036
	(0.030)	(0.038)	(0.025)	(0.035)	(0.025)	(0.035)
% Primary-Women	-0.327***	-0.285***	-0.094***	-0.182***	-0.106***	-0.187***
	(0.030)	(0.046)	(0.024)	(0.041)	(0.024)	(0.042)
% Junior-Men	0.466***	0.112***	0.211***	0.057	0.202***	0.053
	(0.029)	(0.040)	(0.024)	(0.037)	(0.025)	(0.037)
% Junior-Women	0.217***	-0.079*	0.123***	-0.064	0.113***	-0.070
	(0.030)	(0.047)	(0.026)	(0.043)	(0.026)	(0.043)
% High+-Men	0.878***	0.343***	0.239***	0.205***	0.230***	0.202***
	(0.028)	(0.041)	(0.024)	(0.037)	(0.024)	(0.037)
% High+-Women	0.439***	0.051	0.076***	0.011	0.059**	-0.009
	(0.032)	(0.051)	(0.028)	(0.047)	(0.029)	(0.0471)
Foreign-owned			0.030**	0.007	0.029**	0.0065
			(0.013)	(0.024)	(0.013)	(0.024)
Government-owned			-0.018	0.023	-0.018	0.023
			(0.018)	(0.026)	(0.018)	(0.026)
Exporter			-0.005	0.009	-0.005	0.009
			(0.007)	(0.009)	(0.007)	(0.010)
Log Firm Age			0.032***	0.091***	0.032***	0.090***
			(0.003)	(0.011)	(0.003)	(0.011)
Log L			0.015***	-0.017*	0.015***	-0.017*
			(0.003)	(0.009)	(0.003)	(0.009)
Unskilled Ratio			-0.335***	-0.540***	-0.335***	-0.537***
			(0.019)	(0.033)	(0.019)	(0.033)
Log V/L			0.292***	0.233***	0.291***	0.234***
			(0.004)	(0.005)	(0.004)	(0.005)
Log Minimum Wage			0.172***	0.142***		
			(0.018)	(0.026)		
Log Min.Wage*% No Primary-Men					0.357***	0.196
					(0.111)	(0.120)
Log Min.Wage*% No Primary-Women					0.144	-0.175
					(0.121)	(0.123)
Log Min.Wage*% Primary-Men					0.167***	0.038
					(0.044)	(0.052)
Log Min.Wage*% Primary-Women					0.103**	0.126**
					(0.053)	(0.058)
Log Min.Wage*% Junior-Men					0.027	0.063
					(0.051)	(0.070)
Log Min.Wage*% Junior-Women					0.343***	0.358***
					(0.061)	(0.083)
Log Min.Wage*% High+-Men					0.178***	0.102*
					(0.039)	(0.054)
Log Min.Wage*% High+-Women					0.236***	0.356***
					(0.066)	(0.095)
Province Dummies	X		X		X	
Industry Dummies			X		X	
Year Dummies	X	X	X	X	X	X
F-test MW impact Homogeneity					Pr=0.000	Pr=0.000
F-test MW impact No differential gender impact					Pr=0.000	Pr=0.000
N	87939	87939	87785	87785	87785	87785
R^2	0.305	0.120	0.513	0.231	0.513	0.232

Note:-*** p<0.01, ** p<0.05, * p<0.1, standard errors, reported in parentheses, are heteroscedasticity robust and clustered by establishment. Minimum wages, wages and value-added are all measured in real terms. Minimum wage, educational variables and share of female workers are demeaned.

Table 4: Gender Gap in Educational Returns Implied by Table 3

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Gender Wage Gaps (Women – Men)						
% No Primary	-0.808***	-0.328***	-0.255***	-0.222***	-0.267***	-0.250***
% Primary	-0.529***	-0.308***	-0.204***	-0.185***	-0.205***	-0.184***
% Junior	-0.250***	-0.191***	-0.088***	-0.121***	-0.090***	-0.123***
% High+	-0.439***	-0.292***	-0.163***	-0.193***	-0.170***	-0.211***
Log Min.Wage*% No Primary					-0.213	-0.372**
Log Min.Wage*% Primary					-0.064	0.088
Log Min.Wage*% Junior					0.316***	0.295**
Log Min.Wage*% High+					0.058	0.254**
Panel B: Returns to Education By Gender						
Men						
Primary	0.202***	0.023	0.110***	0.003	0.010***	-0.004
Junior	0.466***	0.112***	0.211***	0.057	0.202***	0.053
High+	0.878***	0.343***	0.239***	0.205***	0.230***	0.202***
Women						
Primary	0.481***	0.043	0.161***	0.040	0.161***	0.063*
Junior	1.025***	0.249***	0.378***	0.158***	0.380***	0.180***
High+	1.247***	0.379***	0.331***	0.233***	0.326***	0.241***

Note: *** p<0.01, ** p<0.05, * p<0.1. Reported wage gap in Panel A is calculated as effect on women minus the effect on men, where a negative sign implies that women are paid less. Returns to education in Panel B is calculated by gender relative to omitted category of workers with no primary education. Minimum wage, educational variables and share of female workers are demeaned.

Table 5: Quantile Wage Regressions: Gender Pay Gap with Educational Controls (1993-1997 and 2006)

Dependent variable: log firm-level average wages					
Quantile of Log of Real Prod. Worker Wage:	10	30	50	70	90
	(1)	(2)	(3)	(4)	(5)
% Female	-0.240***	-0.191***	-0.188***	-0.187***	-0.096
	(0.075)	(0.031)	(0.027)	(0.035)	(0.060)
Log Minimum Wage	0.279***	0.162***	0.047*	0.168***	0.070
	(0.081)	(0.040)	(0.028)	(0.049)	(0.070)
Log Min.Wage*% Female	0.546***	0.426***	0.299***	0.017	-0.480***
	(0.129)	(0.056)	(0.047)	(0.059)	(0.120)
Foreign-owned	-0.043	-0.002	-0.000	-0.030	0.114
	(0.050)	(0.025)	(0.022)	(0.035)	(0.075)
Government-owned	-0.016	-0.010	-0.011	0.044	0.108
	(0.066)	(0.028)	(0.025)	(0.033)	(0.073)
Exporter	0.016	0.0218*	0.012	0.010	0.039
	(0.024)	(0.012)	(0.001)	(0.013)	(0.026)
Log Firm Age	0.167***	0.035***	0.026**	0.107***	0.158***
	(0.033)	(0.014)	(0.011)	(0.015)	(0.029)
Log L	0.008	0.014	0.013	-0.039***	-0.088***
	(0.026)	(0.011)	(0.009)	(0.012)	(0.023)
Unskilled Ratio	-0.460***	-0.314***	-0.332***	-0.489***	-0.802***
	(0.083)	(0.035)	(0.029)	(0.039)	(0.081)
Log V/L	0.327***	0.167***	0.144***	0.179***	0.268***
	(0.015)	(0.006)	(0.005)	(0.006)	(0.012)
% Primary	0.109	0.082***	-0.019	-0.032	-0.013
	(0.086)	(0.032)	(0.024)	(0.026)	(0.035)
% Junior	0.293***	0.229***	0.078***	0.028	-0.123***
	(0.082)	(0.033)	(0.025)	(0.030)	(0.045)
% High+	0.106	0.177***	0.152***	0.302***	0.408***
	(0.085)	(0.033)	(0.028)	(0.032)	(0.052)
N	87,785	87,785	87,785	87,785	87,785
R^2	0.036	0.075	0.153	0.217	0.104

Note: *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses are bootstrapped 500 times. Kernel half-width based on optimal selection to minimize mean integrated square error under Gaussian assumption following Silverman 1992. Minimum wages and value-added per worker measured in real terms. Regressions include establishment-level fixed effects. Minimum wage and share of female workers are demeaned.

Table 6. Quantile Wage Regressions: MW Interactions (1994-1997 and 2006)

Dependent variable: log firm-level average wages					
Quantile of Log of Real Prod. Worker Wage:	10	30	50	70	90
	(1)	(2)	(3)	(4)	(5)
Foreign-owned	-0.044	-0.001	-0.000	-0.032	0.110
	(0.049)	(0.024)	(0.023)	(0.034)	(0.078)
Government-owned	-0.015	-0.010	-0.012	0.042	0.106
	(0.066)	(0.029)	(0.024)	(0.034)	(0.071)
Exporter	0.015	0.022*	0.013	0.012	0.038
	(0.023)	(0.011)	(0.010)	(0.014)	(0.027)
Log Firm Age	0.170***	0.037***	0.025**	0.103***	0.155***
	(0.031)	(0.014)	(0.011)	(0.015)	(0.030)
Log L	0.008	0.013	0.012	-0.041***	-0.088***
	(0.025)	(0.011)	(0.010)	(0.012)	(0.022)
Unskilled Ratio	-0.458***	-0.313***	-0.331***	-0.489***	-0.800***
	(0.085)	(0.036)	(0.031)	(0.041)	(0.083)
Log V/L	0.327***	0.167***	0.144***	0.179***	0.268***
	(0.014)	(0.005)	(0.005)	(0.006)	(0.012)
% No Primary-Women	-0.621***	-0.386***	-0.369***	-0.086	0.249**
	(0.205)	(0.076)	(0.060)	(0.074)	(0.104)
% Primary-Men	-0.100	0.039	-0.054	0.032	0.090
	(0.119)	(0.051)	(0.040)	(0.049)	(0.0718)
% Primary-Women	-0.325**	-0.214***	-0.303***	-0.178***	0.131
	(0.133)	(0.054)	(0.046)	(0.056)	(0.084)
% Junior-Men	0.037	0.132***	-0.004	0.079	0.056
	(0.119)	(0.049)	(0.040)	(0.051)	(0.080)
% Junior-Women	-0.066	-0.013	-0.160***	-0.097	-0.035
	(0.133)	(0.059)	(0.050)	(0.062)	(0.088)
% High+-Men	-0.085	0.084*	0.069*	0.348***	0.618***
	(0.116)	(0.050)	(0.041)	(0.053)	(0.087)
% High+-Women	-0.343**	-0.022	-0.037	0.172***	0.300***
	(0.136)	(0.059)	(0.050)	(0.062)	(0.102)
Log Min.Wage*% No Primary-Men	0.473	0.091	-0.170	0.122	-0.093
	(0.450)	(0.167)	(0.137)	(0.168)	(0.220)
Log Min.Wage*% No Primary-Women	1.160**	0.031	-0.295**	-0.340**	-0.546***
	(0.521)	(0.166)	(0.121)	(0.137)	(0.179)
Log Min.Wage*% Primary-Men	0.148	0.175**	0.034	-0.090	-0.082
	(0.174)	(0.078)	(0.066)	(0.080)	(0.117)
Log Min.Wage*% Primary-Women	0.623***	0.606***	0.090	-0.247***	-0.413***
	(0.235)	(0.086)	(0.064)	(0.073)	(0.103)
Log Min.Wage*% Junior-Men	-0.007	0.045	0.138*	0.392***	-0.207
	(0.173)	(0.088)	(0.075)	(0.107)	(0.190)
Log Min.Wage*% Junior-Women	0.562**	0.416***	0.517***	0.477***	-0.184
	(0.264)	(0.109)	(0.101)	(0.131)	(0.209)
Log Min.Wage*% High+-Men	0.091	-0.077	-0.246***	0.045	0.629***
	(0.113)	(0.055)	(0.045)	(0.069)	(0.171)
Log Min.Wage*% High+-Women	0.420*	0.239**	0.209**	0.622***	0.298
	(0.245)	(0.117)	(0.0941)	(0.134)	(0.255)
N	87,785	87,785	87,785	87,785	87,785
R^2	0.037	0.077	0.155	0.220	0.106
Level of Quantile (in '000s Real Rupiahs)	517	935	1,240	1,664	2,687
Level of Quantile (in USD)	41	75	99	133	215

Note: *** $p<0.01$, ** $p<0.05$, * $p<0.1$ Standard errors in parentheses are heteroscedasticity robust and bootstrapped 500 times. Kernel half-width based on optimal selection to minimize mean integrated square error under Gaussian assumption following Silverman (1992). Minimum wages, wages and value-added are all measured in real terms. Province and year dummies as well as a constant included in all regressions. Regressions include establishment-level fixed effects. Minimum wage, educational variables and share of female workers are demeaned.

Table 7: Summary of Gender Wage Gaps and Minimum Wage Impacts from Table 8

Quantile of Log of Real Prod. Worker Wage:	10	30	50	70	90
	(1)	(2)	(3)	(4)	(5)
Panel A: Gender Wage Gaps (Women – Men)					
No Primary	-0.621***	-0.386***	-0.369***	-0.086	0.249**
Primary	-0.225	-0.253***	-0.248***	-0.210***	0.041
Junior	-0.103	-0.145*	-0.156**	-0.175**	-0.090
High+	-0.258	-0.106	-0.106	-0.176**	-0.318**
Panel B: Impacts of Minimum Wages on the Gender Wage Gap at Different Levels of Educational Attainment					
No Primary	0.687	-0.061	-0.125	-0.462**	-0.453
Primary	0.475	0.431***	0.056	-0.157	-0.332**
Junior	0.569*	0.370**	0.379***	0.084	0.023
High+	0.329	0.316**	0.455***	0.577***	-0.331

Note: *** p<0.01, ** p<0.05, * p<0.1. Reported gap and minimum wage effect is calculated as effect on women minus the effect on men. Minimum wage, educational variables and share of female workers are demeaned.

Table 8: The Impact of Minimum Wages on Women's Relative Employment Prospects

	Dependent Variable: % Female Prod. Workers					
	OLS	FE	OLS	FE	OLS	FE
	('93-'06)	('93-'06)	('93-'06)	('93-'06)	('95-'97, '06)	('95-'97, '06)
	(1)	(2)	(3)	(4)	(5)	(6)
Log Minimum Wage	-0.021***	0.006*	-0.012**	0.007*	0.018**	0.009
	(0.007)	(0.004)	(0.006)	(0.004)	(0.008)	(0.007)
Foreign-owned			0.023***	-0.002	0.033***	0.010
			(0.006)	(0.004)	(0.006)	(0.007)
Government-owned			-0.110***	0.001	-0.134***	0.004
			(0.007)	(0.002)	(0.008)	(0.005)
Exporter			0.028***	0.002**	0.038***	0.004
			(0.003)	(0.001)	(0.004)	(0.002)
Log Firm Age			-0.014***	-0.003**	-0.017***	-0.004
			(0.001)	(0.002)	(0.001)	(0.003)
Log L			0.058***	0.031***	0.069***	0.031***
			(0.001)	(0.002)	(0.001)	(0.003)
Unskilled Ratio			0.446***	0.104***	0.379***	0.104***
			(0.008)	(0.006)	(0.009)	(0.010)
Log V/L			-0.055***	-0.003***	-0.056***	-0.005***
			(0.001)	(0.001)	(0.001)	(0.001)
% Primary					-0.027***	-0.015**
					(0.008)	(0.006)
% Junior					-0.008	-0.017***
					(0.008)	(0.006)
% High+					-0.147***	-0.046***
					(0.009)	(0.007)
Province Dummies	Yes	No	Yes	No	Yes	No
Industry Dummies	No	No	Yes	No	Yes	No
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	273531	273531	272372	272372	87815	87815
R^2	0.029	0.000	0.327	0.017	0.342	0.0274

Note: *** p<0.01, ** p<0.05, * p<0.1, Standard errors, reported in parentheses, are heteroscedasticity robust and clustered by establishment. Minimum wages, wages and value-added are all measured in real terms. Minimum wage, educational variables and share of female workers are demeaned.

Table 9: The Impact of Minimum Wages on Women's Relative Employment Prospects by Level of Education

Dependent Variable: % of Production Workers who are Men/Women with Education Level:	Men				Women			
	No Primary	Primary	Junior	High+	No Primary	Primary	Junior	High+
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Baseline Model *(N=87971)*								
	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Log Minimum Wage	0.003	-0.074***	-0.012**	0.060***	0.011***	-0.012*	0.008	0.025***
	(0.003)	(0.007)	(0.006)	(0.008)	(0.003)	(0.006)	(0.005)	(0.005)
R^2	0.083	0.067	0.015	0.067	0.040	0.065	0.026	0.068
	FE	FE	FE	FE	FE	FE	FE	FE
Log Minimum Wage	-0.005	0.027***	-0.030***	-0.001	-0.000	0.039***	-0.023***	-0.009
	(0.004)	(0.008)	(0.008)	(0.009)	(0.004)	(0.008)	(0.007)	(0.006)
R^2	0.016	0.095	0.011	0.087	0.014	0.069	0.028	0.059
Panel B: Model with Firm Controls *(N= 87785)*								
	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Log Minimum Wage	0.003	-0.036***	-0.006	0.024***	0.017***	-0.004	-0.006	0.004
	(0.003)	(0.007)	(0.006)	(0.007)	(0.003)	(0.006)	(0.005)	(0.004)
R^2	0.083	0.195	0.101	0.401	0.156	0.246	0.152	0.263
	FE	FE	FE	FE	FE	FE	FE	FE
Log Minimum Wage	-0.005	0.027***	-0.030***	-0.001	-0.000	0.039***	-0.023***	-0.009
	(0.004)	(0.008)	(0.008)	(0.009)	(0.004)	(0.008)	(0.007)	(0.006)
R^2	0.016	0.095	0.011	0.087	0.014	0.069	0.028	0.059

Note: *** p<0.01, ** p<0.05, * p<0.1. Standard errors, reported in parentheses, are heteroscedasticity robust and clustered by establishment. Minimum wages, wages and value-added are all measured in real terms. Controls included but not presented in Panel A: Baseline Model are year dummies (OLS and FE) and province dummies (OLS only). Controls included but not presented in Panel B: Model with Firm Controls are exporter status dummy, unskilled ratio, log firm age, foreign owned, government owned, log L, log V/L year-dummies (OLS and FE) and province- and industry- dummies (OLS only). Minimum wage is demeaned.

Appendix A: Data Construction

A.1 Construction of Key Explanatory Variables

Exporters were identified for 1993-2000 based upon reporting that the share of output exported was nonzero, and for 2001-2006 based upon a variable identifying whether *any* output was exported (both variables are not available in the data for all years).

Firm age was constructed using the difference between the survey year and the year the firm reported the start of production.

Foreign owned firms based upon whether foreign ownership was reported to be non-missing and non-zero.

Government owned firms were defined the same way based on both local and national government.

Minimum wages. Minimum wages were obtained from BPS as monthly provincial minimum wages set by each province (or averages where there is within-province variation across districts) for each year. These reflect the nominal rupiah amount that all formal sector workers are required to be paid at or above. To obtain minimum wages in real terms, we deflated provincial minimum wages by the corresponding provincial CPI obtained from BPS. We thank David Newhouse for making these data available to us.

Wages (firm-level average) Wages are defined as the average wage for production or non-production workers, constructed as the total wage bill for either group divided by the number of workers of either respective group. The total wage bill for production (non-production) workers was defined as the sum of cash wages/salary and in-kind benefits for production (non-production workers) deflated to 1993 rupiah using the national consumer price index obtained from the World Development Indicators. Real wages are constructed by deflating the nominal wage bill reported to BPS by provincial CPI obtained from BPS.

Sector of main product In order to classify establishments by industry, BPS records the five-digit International Standard Industrial Classification (ISIC) for firms based on the product with the largest production value in any given year. In 2001, BPS changed the classification of plants from the second revision of the ISIC to the third. A consistent bridge between these different coding systems was constructed based upon the inclusion of both codings in the dataset for the 2000 survey database. This bridge was corroborated using a bridge provided by BPS. In many cases, the industry code provided in the dataset was truncated to four or fewer digits. Where possible, if an adjacent year's reported industry for the same firm was available that was used to fill in the truncated digits. Where plants produce multiple products or the production processes allow changing from one product to another, we may expect to see the coded industry of production change from year to year. In such cases, the mode sector code is used (with ties going to the initial sector code reported).

Total labor for an establishment was defined as the sum of all paid and non-paid workers, whether production or non-production workers.[xvii] Production workers were defined by BPS as all workers who work directly in the production process or activities connected with production process, and non-production workers were defined to be all other workers. These definitions roughly correspond to traditional definitions of blue- and white-collar workers, respectively (see below).

Unskilled ratio The unskilled ratio was constructed as the share of blue collar workers (including unpaid production workers) as a share of the total establishment employment.

% No Primary-Men(/Women) Proportion of production works who were men (women) that did not complete primary school

% Primary-Men(/Women) Proportion of production workers who were men (women) and for whom primary school was their highest level of schooling.

<u>% Junior-Men(/Women)</u> Proportion of production workers who were men (women) for whom junior high school – either technical or vocational - was their highest level of schooling.

<u>% High +-Men(/Women)</u> Proportion of production workers who were men (women) who, at a minimum, completed high school: workers with a Bachelors, Masters or PhD degree are also included in this category.

A.2 Data Cleaning Procedures

The problem of non-persistent extreme values for many variables is widely discussed in published work using the SI (see for example, Blalock et al., 2008, Rijkers and Hallward-Driemeier, 2013). In some cases, these values may be the result of key punch errors, where, for example, ownership share is recorded as 340 percent rather than 34 percent. Where shares (exports and ownership) were reported, these were easily corrected, but for balance sheet variables, more extensive cleaning was required.

These likely key punch errors and other highly volatile trends were corrected in the data by identifying firms with implausibly large non-persistent changes over one or two years and replacing values with those of preceding and succeeding years (or just one or the other of the observation was at beginning or end of the series). Based on close observation of normal variation of these variables, the thresholds for identifying large non-persistent shifts were a 100% change in labor, a 200% in real value added and real output, a 150% change in real inputs, and 100% change in capital and average wages. Next, firms were dropped from the data when they had such a significant number of non-persistent jumps that it was impossible to interpolate (this constituted less than 1% of the sample). Finally remaining outliers were identified by eyeballing plots of key relationships (for example inputs per worker) and spot interpolating obvious remaining outliers.

Appendix B: Further Details on Re-centered Influence Function (RIF) Regression

In section 6 of the paper, we perform unconditional quantile regression to estimate the marginal effect of minimum wage increases on the gender wage gap for production workers. This estimation is performed via the re-centered influence function approach (RIF) laid out in Firpo, Fortin and Lemieux (2009), hereafter FFL. The goal of the approach is to obtain the estimated effect of covariate *X* on the τ^{th} quantile of outcome variable *Y*, the so-called Unconditional Quantile Partial Effect (UQPE):

$$\frac{dq(F_Y)}{dX} = \frac{1}{f_Y(q_\tau)} \cdot E\left[\frac{dPr(Y > q_\tau|X)}{dX}\right].$$

Specifically, this effect is identified via re-centered influence function (RIF) estimation. RIF estimation is a modification of influence function estimation introduced by Hampel (1974) to study small modifications to real-valued probabilistic functionals. The logic of the Influence Function is to measure the influence of adding an infinitesimally small amount of noise to point *y* in distribution *Fy* on some distributional statistic. The influence function (*IF*) is the expected effect on any particular quantile of small deviation ε from distribution F_Y to G_Y:

$$lim_{\varepsilon\to 0} \frac{q\left(F_{Y,\varepsilon\cdot G_Y}\right) - q(F_Y)}{\varepsilon} = \int IF\,(y; q, F_Y) \cdot d(G_Y - F_Y)(y)$$

$$= \int \left.\frac{\partial q\left(F_{Y,\varepsilon\cdot\Delta y}\right)}{\partial\varepsilon}\right|_{\varepsilon=0} \cdot d(G_Y - F_Y)(y),$$

where $F_{Y,\varepsilon\cdot G_Y} = (1-\varepsilon)\cdot F_Y + \varepsilon\cdot G_Y$ is the mixing distribution of *G* and *F*. The re-centered influence function is then the *IF* re-centered relative to the estimate itself:

$$RIF(y; q, F_Y) = q(F_Y) + \int IF\,(s; q, F_Y) \cdot d\Delta y(s)$$

$$= q(F_Y) + IF(q, F_Y).$$

Given a conditional expectation of *q*, we can estimate the conditional expectation of the *RIF* using the law of iterated expectations:

$$q(F_Y) = \int RIF(y; q, F_Y) \cdot dF_Y(y)$$

$$= \int \int RIF(y; q, F_Y) \cdot dF_{Y|X}(y|X = x)dF_X(x)$$

$$= \int E[RIF(y; q, F_Y)|X = x] \cdot dF_X(x).$$

Now by integrating over the expectation of the RIF alone, we avoid having to integrate over the entire conditional distribution (as is typically done in other approaches to estimating the unconditional quantile effect). Estimation of the RIF for a particular quantile τ is straightforward:

$$RIF(y; q, F) = q_\tau + \frac{\tau - 1\{y \leq q_\tau\}}{f_Y(q_\tau)},$$

where f_Y is the probability distribution function of outcome variable *Y*, and *1*{} is an indicator function. As shown in FFL, this can be done by estimating the sample quantile of interest, $\hat{q}_\tau = argmin_q \sum_{i=1}^{N} (\tau - 1\{Y_i - q \leq 0\}) \cdot (Y_i - q)$ following Koeneker and Bassett (1978), and then the sample density of *Y* is obtained via kernel density estimation:

$$\widehat{f_Y}(\hat{q}_\tau) = \frac{1}{N \cdot b} \cdot \sum_{i=1}^{N} \mathcal{K}_Y\left(\frac{Y_i - \hat{q}_\tau}{b}\right),$$

where $\mathcal{K}_Y(\cdot)$ is a kernel function and *b* is the positive scalar bandwidth.

After estimating the quantile of interest and the associated kernel density to construct the empirical RIF, we employ the RIF-OLS estimator described by FFL. The average marginal affect can be obtained by regressing $\widehat{RIF}(Y; \hat{q}_\tau)$ on *X* using OLS. Fixed Effects estimation is similarly implemented by performing within transformation on the variables in the model, including the dependent variable. Following Frisch-Waugh's theorem, we can interpret the estimate of regressions of this transformation on demeaned covariates as equivalent to partialling out the effect any time-invariant firm-level variation on the quantile of interest, so interpretation of this fixed effects model is straightforward.

The estimation proceeds in three steps; (i) The quantile of interest is estimated from the distribution, then (ii) the RIF function is constructed across the distribution of observations in the data, and (iii) finally the

RIF is regressed on the covariates of interest for the given model. The entire procedure is bootstrapped to ensure consistent estimation of the associated standard errors.

Appendix References:

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[i] For ease of exposition throughout the text, we interchangeably refer to workers or production workers.

[ii] Firm-level data often do not contain detailed information on the characteristics of individual workers, which may be a bigger drawback than not having information on firm characteristics.

[iii] For example, Grindling and Terrell (2005) look at a 12 year panel in Costa Rica, Lemos (2009) looks at Brazil, while Maloney and Nuñez-Mendez (2004) look at a number of Latin American countries, focusing on Colombia. All find evidence consistent with wage compression, i.e. that minimum wages serve to raise wages relatively more at the lower end of the wage distribution. Maloney and Nuñez-Mendez (2004) show kernel distributions of wages for eight Latin American countries, which exhibit a bunching of firms paying just above the minimum wage – while there is not full compliance, there is certainly a significant share of firms that find the minimum wages binding. In addition, these papers also find impacts of higher minimum wages across the wage distribution, consistent not only with lighthouse effects at wages above the level of minimum wages, but also in the informal sector.

[iv] Existing studies typically find that impacts on employment from minimum wages are small on average, but heterogeneous across firms. Using province level-aggregates, Rama (2001) finds that that a doubling of the minimum wage caused wage employment to fall by less than 5 per cent. However, small firms reduced employment more than large firms. Similar conclusions are reached by Alatas and Cameron (2008). Harrison and Scorse (2010) employ a difference in difference approach and regress employment growth between 1990 and 1996 on the change in minimum wages (for those firms for whom it is likely to be binding) and find that a doubling of the minimum wage would reduce employment by approximately 12.3 per cent in firms which were affected by such minimum wage increases (that is, who were paying wages in 1990 that were below the 1996 minimum wage).

[v] The SI data track establishments, rather than *firms*. A recent BPS study has suggested that less than 5% of establishments in the Manufacturing Census are owned by a multi-establishment firm (see Blalock et al. 2008 for discussion). For this reason, we believe that our results for establishments are likely to generalize to firms and we will use the terms "firms" and "plants' interchangeably in the remainder of the text.

[vi] We demean minimum wage interactions such that we can continue to interpret the coefficients on the composition of the production workforce as being indicative of average gender pay differentials.

[vii] Note, export status and ownership do vary over time and are appropriate to include in the fixed effects specification.

[viii] The results presented below are also robust to using measures of total factor productivity to control for productivity. Results are omitted to conserve space, but available from the authors upon request.

[ix] The RIF function serves to invert proportions of the sample below a particular quantile back into the quantiles themselves by dividing these proportions by estimates of the density of the dependent variable.

[x] It should be noted that RIF estimates are to be interpreted as a local approximation for the effect changes in the distribution of minimum wages on firm-level average wages.

[xi] Note that due to data limitations quantiles are based on average wages at the firm-level, not at the level of individual workers.

xii Given the size of some of the coefficients, this approximation in interpreting the coefficients as percent point changes is not strictly accurate. The exponential values can be calculated; our emphasis here is on the general significance and overall size of the effects.

[xiii] As education variables are only available for some years, we also tested the robustness of the results on the subsample of those years compared to the whole sample. Results are robust and are available upon request.

[xiv] One possible explanation for this finding could be that men were paid wages in excess of minimum wages prior to the minimum wage increase.

[xv] Note that this approach is dividing firms based on their position of the distribution of average wages, and then looking at how wages within each group varies with the gender and educational composition of firms' production workforces.

[xvi] The specifications show that exporting plants, larger plants, and plants with relatively fewer white collar workers employ proportionately more women, whereas older firms, and more productive firms tend to employ fewer women