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IZA DP No. 13878

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ISSN: 2365-9793

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ABSTRACT

The Impact of Minimum Wages on Wages, Wage Spillovers, and Employment in China: Evidence from Longitudinal Individual-Level Data*

We use the substantial variation in both the magnitude and frequency of minimum wage changes that have occurred in China since its new minimum wage regulations in 2004 to estimate their impact on wages, wage spillovers, and employment. We use county-level minimum wage data merged with individual-level longitudinal data from the Urban Household Survey for the period 2004–09, spanning the period after the new minimum wage regulations were put in place. Our results indicate that minimum wage increases raise the wages of otherwise low-wage workers by a little less than half (41%) of the minimum wage increases. Depending upon the specification, these wage effects also lead to a 2 to 4 percentage point reduction in the probability of being employed, with a 2.8 percentage point reduction being our preferred estimate. We also find statistically significant but very small wage spillovers for those whose wages are just above the new minimum wage, but they are effectively zero for those higher up in the wage distribution.

JEL Classification: J38, J88
Keywords: minimum wage, China, wages, employment, wage spillovers

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* Tony Fang would like to acknowledge the generous financial support from the Social Science and Humanities Research Council (435-2019-0271) and the National Social Science Fund of China (19BGJ005). Morley Gunderson would like to acknowledge financial support from the Social Science and Humanities Research Council of Canada' Insight Grant. Carl Lin thanks the financial support from the Bucknell Institute for Public Policy (BIPP).

1. Introduction

There is a growing literature on the impact of minimum wages in China, most of which focuses on the impact on employment. Recent examples, that also review that literature, include Long and Yang (2016) and Wang and Gunderson (2018) as well as studies written in Chinese including Guo and Zhang (2018) and Zhang and Yang (2016).

In contrast to most previous studies that use aggregate level data to examine the minimum wage effects in China,[1] our study uses nationally representative data at the individual level and provides evidence on the impact of minimum wages in China on wages, wage spillovers, and ultimately on employment. The main contributions of the paper are: (1) Our empirical analysis spans the years 2004 to 2009[2] so we are able to take advantage of the substantial variation in both the magnitude and frequency of minimum wage changes that have occurred in China since their new minimum wage regulations in 2004. (2) We merge county-level minimum wage data (which is the level where minimum wages tend to be set) with individual-level data (which is the level where wage and employment effects occur). (3) The individual-level data enables us to use both the "at-risk" and wage gap methodologies (outlined subsequently) for estimating wage and employment effects. (4) We estimate both the wage and employment effects of minimum wage increases, which provides corroborating evidence since positive wage effects and negative employment effects would go hand-in-hand. (5) We estimate wage spillovers to see if minimum wages have ripple effects on the wages of those who are above the new minimum wage and who may be indirectly affected. (6) Our data is longitudinal at the individual level so we are able to use individual and year fixed-effect panel estimation procedures to better control for unobservable factors that can otherwise contaminate the estimates of minimum wage impacts. As well, we use a wage gap adjustment methodology for both treatment and control groups that essentially controls for within-group heterogeneity for both groups as outlined in Campolieti, Fang and Gunderson (2005).

Theoretical Expectations of Minimum Wage Effects on Employment, Wages, and Spillovers

Basic economic theory predicts that minimum wage increases will reduce employment as firms substitute other inputs for the workers whose wages have increased, and as firms reduce their output in response to the higher costs. Such conventional adjustments may not occur in situations of monopsony (Manning 2003; Bhaskar, *et al*., 2002; Dong and Putterman 2000, 2002)

or when there are cost offsets from such factors as management being shocked into more efficient practices or because of improvements in employee commitment and loyalty to the firm and reductions in turnover (Cooke, 2005; Hirsch, Kaufman and Zelenska 2005; Metcalf, 2008). Cost offsets can also occur through firms cutting back on fringe benefits and non-wage components of compensation (Long and Yang, 2016; Metcalf, 2008; and Wang and Gunderson, 2012).

Basic economic theory also highlights the complementarity between wage and employment outcomes. If wages do not increase (perhaps because of non-compliance or minimum wages being a non-binding constraint) then there also should be no adverse employment effect.

The theoretical literature also has implications for wage spillover effects, especially for workers just above the minimum wage. Campolieti (2015) provides a thorough review of the literature on such spillover effects and highlights the mechanisms through which they can work. Positive wage spillovers can occur if employers substitute some higher-paid employees for the now more costly low-wage workers affected by the minimum wage, and they may raise wages of those above the minimum wage to restore former wage relativities, as emphasized in the industrial relations literature. In contrast, if such higher-wage workers are complements in production to the lower wage minimum wage workers, then any reduction in the employment of minimum wage workers would also lead to reductions in the employment and wages of workers above the minimum wage. Clearly, the spillover effect from minimum wage increases onto the wages of those above the minimum wage is ultimately an empirical proposition, although it would likely increase those wages. The effect should clearly be largest for those just above the new minimum wage and then declining rapidly with no substantial effect on higher wage groups.

2. Minimum Wage Legislation in China

The evolution of minimum wages in China is well documented in studies such as Fang and Lin (2015), Long and Yang (2016), Wang and Gunderson (2012, 2018), and Xing and Xu (2015). For the purpose of our study, the main changes involved "The Minimum Wage Regulations" that came into effect on March 1, 2004. The regulations became much more stringent and coverage was extended to part-time workers and to those in towns and villages, in state-owned enterprises, private enterprises, private non-enterprise units, as well as employees in

self-employed businesses. The new laws set up a monthly minimum wage and an hourly minimum wage separately for fulltime and non-fulltime workers, respectively.

Figure 1 shows the nominal and the real average minimum wages as well as the frequency of minimum wage increases at the county level over the sample period. In panel A of Figure 1, both nominal and real average minimum wages tracked each other quite closely, with the real minimum wage falling below the nominal minimum wage after 2009 as nominal increases did not keep up with inflation. As shown in panel B, there is a jump and upward trend in the percent of counties that instituted minimum wage increases since the minimum wage regulations of 2004. In essence, the new legislation resulted in substantial increases in minimum wages, both in terms of frequencies and magnitudes, especially in the Central and Western regions.

[Figure 1 about here]

Table 1 shows the variation of minimum wages by presenting average real minimum wages for the 31 provinces and autonomous regions across the country over the 2004–09 period. Importantly for research purposes, the changes in minimum wages and their magnitudes both over time and across counties provide substantial variations from which to identify minimum wage effects. Specifically, over the period 2004–09 of our survey data for 16 provinces, there were 124 minimum wage increases at the county level, with mean real minimum wages rising by 63% from 346 RMB to 563 RMB (converted to 2009 units using the urban CPI at the province level). Such variation is crucial for estimating the impact of policies such as minimum wages. In his presidential address to the Society of Labor Economists, Hamermesh (2002) called for more international evidence on the impact of policy initiatives and he specifically singled out minimum wage legislation as benefiting from evidence from countries where there is considerable variation across jurisdictions and over time. China post-2004 certainly fits that bill.

[Table 1 about here]

3. Data

Our empirical analysis is based on individual-level longitudinal survey data from the Urban Household Survey (UHS) for the years 2004–09, covering the period after the new minimum wage regulations were put in place in 2004.[3] The UHS is a continuous, large-scale social-economic survey conducted by China's National Bureau of Statistics (NBS) aiming to study the

conditions and standard of living of residents in the urban households, which include agricultural and non-agricultural residents or non-residents who live in the urban areas for at least six months.[4]

Note that the individual-level data is an unbalanced panel. The UHS handbook (Wei, 2006) indicates that the sample households are followed and replaced after three years. In practice, however, local authorities have the flexibility to retain some households in the survey beyond the three years and sometimes less than the three years. This flexibility somewhat mitigates the possibility of attrition bias that could occur if the attrition was systematically related to minimum wages. Such attrition bias is a common problem in using panel data. To address this concern, we calculated descriptive statistics for key variables of interests (e.g., employment rate) over the sample period and didn't observe systematic attrition bias towards one group of individuals (for example, those with employment status switched from being employed to being unemployed). The possibility of attrition bias from not being able to match individuals over time may also be mitigated by the fact that we match such individuals by using not only household ID numbers but also several individual characteristics such as gender, age, educational attainment, year when an individual began to work, and length of stay in the current city.

We report the panel structure of the data in Table 2. Consistent with the survey guidelines in the UHS handbook, 97% of at-risk (workers' monthly wages fall between the old and the new minimum wages when there is an increase in the minimum wage) and not-at-risk (workers are not affected by a minimum wage increase) observations are replaced after three years. For individuals "at-risk" of being affected by a minimum wage increase, for example, 45% appear in the dataset for one year, 38% for two consecutive years, 13% for three consecutive years, 3% for four consecutive years, and negligible numbers for more than four years. We then incorporate the county-level data on minimum wages (over 2000 counties each year at the 6-digit code) as well as variables to control for economic conditions such as GDP per capita and the CPI, which can affect wage and employment outcomes. We also include a measure of city-level foreign direct investment (FDI) to control for possible omitted variable bias in that such investment can be correlated with minimum wages (cities may restrain minimum wages to attract FDI) as well as wage and employment outcomes.

[Table 2 about here]

Most minimum wage studies for China use aggregate level data. Our use of individual-level data, however, involves the level of aggregation where wage and employment decisions in response to minimum wage changes are actually made. It also enables estimating spillover effects on wages just above the minimum wage. The longitudinal aspect of the individual-level data enables following the same individual over time and hence controls for unobserved heterogeneity that is fixed within the individual as well as overtime. We use minimum wage data at the county-level rather than the provincial-level data that is conventionally used in China. This allows for a more accurate measure of the minimum wage at the level where it is set, and it enables controlling for local labor market conditions. The large number of minimum wage changes at the county-level also provides more variation in the "treatment" to help identify the effect of minimum wages. Our minimum wage dataset for each county was compiled by recording the minimum wage data from every local government website for approximately 2,300 counties every year from 1994 to 2012 (we used only the 2004–09 data in the empirical analysis in order to match with the survey data after the 2004 minimum wage reforms and prior to the most recent data available to us, 2009).

Enforcement of labour laws is often regarded as weak in China (Deng and Li 2012; Rawski, 2006). Fang and Lin (2015), however, provide evidence that enforcement of minimum wage laws has increased over time, especially after the 2004 reforms. As such, we would expect wage and employment effects in the 2004–09 period of our data.

As discussed, minimum wage information at the county level is important given that minimum wages are effectively set at that level of aggregation, and they can vary by counties within the same province, even for geographically contiguous neighbors within the same province. To address the potential issue that counties in a province within the same year may experience different adjustment dates of the minimum wage, we use the time-weighted method as in Rama (2001) to obtain the mean minimum wage.[5] For our empirical analysis, the minimum wage data is then merged into the 16-province UHS data over the 2004–09 period, with individuals matched to their county-level minimum wage. The minimum wages and individual wages are adjusted for inflation and converted into 2009 RMB using the urban resident CPI at the province level, which accounts for differing living costs among provinces by applying the PPP-adjusted deflator developed by Brandt and Holz (2006).

Table 2 gives the descriptive statistics for our data for those who are "at-risk" of being affected by a minimum wage increase in that their wages fall between their old and new minimum wages, and those not "at-risk" of being affected in that their wages are not affected by minimum wage increases. Our preferred control group (MinWage + 80 RMB) is those who did not experience a minimum wage increase but are given a hypothetical minimum wage increase at the average minimum wage increase of approximately 80 RMB. The ratio of at-risk workers to total workers including those in that comparison group (at-risk and not-at-risk) is 0.512 (i.e., the at-risk treatment group and the preferred comparison groups are of about equal size). The average probability of being employed is 0.900 for the at-risk group and 0.936 for the not-at-risk group, suggesting that we should have sufficient observation in both the not employed and employed groups to make inferences. The at-risk individuals and not-at-risk individuals are quite similar, respectively, in age (41, 42), Han ethnicity (98%, 97%), Local hukou (97%, 98%), years of residence (33.7, 31.7), and years of work experience (23.8, 23.2). Not surprisingly, not-at-risk individuals are more likely to be male (56%, 38%), married (90%, 85%), to have more years of schooling (12.7, 11.2), and earn significantly higher monthly wages (1781, 489), than at-risk individuals. The average monthly minimum wage over the period was 544 RMB, and the average monthly wage for those at risk in that their wage fell between the old and the new minimum wage was 489 RMB. The average wage gap, defined as the difference between the individual's monthly wage and the new monthly minimum wage was 55 RMB. For those not at risk their wages are obviously much higher, hence the large negative gap when subtracted from the minimum wage.

Those at risk of being affected by a minimum wage disproportionately are in the low education categories. They are also more likely to be in service and agricultural occupations and less likely to be in public sectors or technical sectors. Those at risk of being affected by a minimum wage are also more likely to be in sales and housekeeping industries and less likely to be in education or public service ones. As indicated previously, a comparison with the 2005 Census indicates that our data is fairly representative of the workforce in those provinces.

4. Estimating Equations

Wage effect equations

The effects of minimum wage increases on the wages of those who should be affected by such increases are of importance in determining if minimum wage increases have their intended effect of increasing the wages of low-wage workers. As well, if there is no effect on the wages of those who should be affected, then this suggests that enforcement is lax or that the minimum wages are a non-binding constraint in that they do not "bite" into the wage distribution.

We use fixed-effects panel regressions at the individual level to estimate the effect of minimum wages to see whether changes in the minimum wage affect the observed wages of the at-risk individuals who remain employed after the minimum wage increase and whose wages should be directly affected by minimum wage increases. Minimum wage studies that have used variants of the "at-risk" methodology include: Ashenfelter and Card (1981), Campolieti, Fang and Gunderson (2005), Currie and Fallick (1996), Draca, Machin and VanReenen (2011), Egge, Kohen, Shea, and Zeller (1970), Fang and Gunderson (2009), Linneman (1982), Yuen (2003) and Zavodny (2000).

An individual is at-risk (i.e., bound by the change) if the person was working at a wage between the old (MW_{t-1}) and the new minimum (MW_t); that is, $\mathrm{MW}_{t-1} \leq \mathrm{Wage}_{t-1} < \mathrm{MW}_t$. Our wage equation is:

$$W_{i,t}^{j} = a_0 + a_1[MW_{i,t}^{j} \times AtRisk_{i,t}^{j}] + X_{i,t}\theta + \mu_i + \tau_t + \lambda t + \varepsilon_{i,t}, \qquad (1)$$

where $W_{i,t}^{j}$ is the log of the wage for individual *i* in county *j* in year *t*; $MW_{i,t}^{j}$ is the log of the minimum wage (in levels) of individual *i* received in county *j* the person works in year *t*; $AtRisk_{i,t}^{j} = 1$ if the monthly wage of worker *i* from county *j* in year $t-1$ was between the old and the new minimum wages when there is an increase in the minimum wage in county *j* of year *t* (treatment group); otherwise, $AtRisk_{i,t}^{j} = 0$ if the worker is not affected by a minimum wage increase (control group)[6]; for control groups, we use MinWage + XXX (current minimum wage plus XXX Chinese RMB) to mimic the counterfactual increase for these groups who do not experience a minimum wage increase, and XXX is between 10 and 200 RMB; X is a set of individual characteristics that exhibit within variation in our data such as years of schooling, marital status, work experience, work experience squared, occupation, and industry; μ_i is a set of individual fixed-effects; λt is the city-specific linear time trend; and τ_t is a set of year fixed-effects; $\varepsilon_{i,t}$ is the error term.

The treatment group consists of low-wage workers (defined by those whose wages are bound by the old and new minimum wages) in the counties where minimum wage changes took place. The control or comparison group includes those low-wage workers in the counties with no minimum wage changes, but who are otherwise similar to the treatment group in that their wages are between their own current minimum wage and their current minimum wages plus the hypothetical minimum wage change measured as the average minimum wage changes in the counties where such changes actually occurred.[7] In essence, they are a comparison group that could have been affected by a minimum wage increase like that of the treatment group but they did not experience that minimum wage increase. As such, the coefficient for the interaction terms between $MW_{i,t}^{j}$ and $AtRisk_{i,t}^{j}$ captures the counterfactual for the wage changes of those who were affected by minimum wage changes relative to those who were not affected in the provinces without minimum wage changes but otherwise would have been affected if similar minimum wage increases were introduced.

Wage spillover equation

As discussed previously, examining the spillover effects on the wages of others in the wage distribution whose wages may be indirectly affected by minimum wage increases is important to determine if minimum wage increases also give rise to an indirect ripple effect beyond those who are directly affected by minimum wage increases. A large ripple effect could exacerbate the cost increases for employers, and it could mean that the wage effects are spilling over into higher wage groups.

The spillover effects are measured by wage changes for those whose wages were slightly above the new minimum wages in those jurisdictions that increased their minimum wage. As such, the coefficient for the interaction terms between $MW_{i,t}^{j}$ and $AtRisk_{i,t}^{j}$ captures the counterfactual for the wage changes of those whose wages are slightly above current minimum wages as the result of minimum wage changes (treatment group) relative to those who were not affected in provinces without minimum wage changes but otherwise would have been affected if similar minimum wage increases were introduced (control group).

We estimate the wage spillover effects as:

$$W_{i,t}^{j} = a_0 + a_1[MW_{i,t}^{j} \times MWAdj_{i,t}^{j}] + X_{i,t}\theta + \mu_i + \tau_t + \lambda t + \varepsilon_{i,t}, \qquad (2)$$

where $W_{i,t}^{j}$ is the log of the wage for individual *i* in county *j* in year *t*; $MW_{i,t}^{j}$ is the log of minimum wage levels in county *j* for worker *i* in year *t*; $MWAdj_{i,t}^{j}$ is a set of dummy variables equal 1 if the wage of worker *i* in county *j* falls into the range [New MinWage + XXX] < Wage $\leq$ [New MinWage + (XXX + 20)] and is in a jurisdiction that experiences a minimum wage increase (treatment group) and equal 0 if a worker's wage is in the same range but is in a jurisdiction that does not experience a minimum wage increase (control group); XXX is between 0 and 200 RMB and with increments of 20 RMB. For example, the first spillover category (XXX is zero) is for those whose wage falls between the new minimum wage and 20 RMB above the minimum wage; the second spillover category (XXX is 20) is for those whose wage falls between 20 RMB above the new minimum wage and 40 RMB above, and so forth. X is a set of individual characteristics as indicated before; μ_i is a set of county fixed- effects; λt is the city-specific linear time trend; τ_t is a set of year fixed-effects, and $\varepsilon_{i,t}$ is the error term. We estimate the model using OLS, separately for each of the 10 wage spillover categories, indicated in Table 4.

Employment effect equations

We use individual wages and employment status to identify those employed workers who were most likely to be directly affected ("bound", at risk) by the changes in the minimum wage in those years.[8] We then examine whether these individuals have a lower probability of being employed one year later. As stated in Currie and Fallick (1996), the procedure does not introduce any selection bias into our estimates since initially employed individuals constitute the appropriate population for estimating the effect of the minimum wage on the transition out of employment.

As conventional in the literature, we use a Linear Probability Model to estimate the effect of minimum wage changes on the probability of remaining employment in the subsequent period using (1) an at-risk methodology and (2) a wage gap methodology.[9] The at-risk methodology estimates the probability of a worker being employed in year t conditional on the worker being employed in year $t-1$. The wage gap methodology uses the magnitude of the increase in the worker's wage necessary to bring it to the new minimum wage as the key independent variable. The gap methodology exploits the considerable variation in the magnitude of the wage adjustment in the data. It also controls for within-group heterogeneity arising from workers who

may have a large gap or wage adjustment necessary to bring their wages up to the new minimum wage. Such workers are disproportionately likely to have unobserved characteristics that may lead to employment instability that puts them in the bottom part of the wage gap thereby experiencing a large wage adjustment and hence a greater probability of job loss (Campolieti, Fang and Gunderson 2005). The at-risk and wage gap methodology as empirical equations are shown below, respectively.

$$E_{i,t}^{j} = \alpha\, AtRisk_{i,t}^{j} + X_{i,t}\beta + \varepsilon_{i,t} \tag{3}$$

$$E_{i,t}^{j} = \alpha[Wagegap_{i,t}^{j} \times AtRisk_{i,t}^{j}] + X_{i,t}\beta + \varepsilon_{i,t} \tag{4}$$

where $E_{i,t}^{j} = 1$ if the worker *i* in county *j*, who was employed in year $t-1$, was employed in year *t*, and $E_{i,t}^{j} = 0$ otherwise. $AtRisk_{i,t}^{j} = 1$ if the monthly wage of worker *i* from county *j* in year $t-1$ was between the old and the new minimum wages when there is an increase in the minimum wage in county *j* of year *t*; otherwise, $AtRisk_{i,t}^{j} = 0$ if the worker is not affected by a minimum wage increase. The $AtRisk$ variable captures the effects of the minimum wage increase on the conditional probability of employment for the at-risk group. X is the vector of individual characteristics as before.

$Wagegap_{i,t}^{j}$ is defined as the difference between the minimum wage in year *t* and the worker *i*'s wage from county *j* in year $t-1$ if the worker is affected by the minimum wage change in year *t*. For workers in the control group, the $Wagegap$ is the hypothetical wage adjustment that would be necessary to raise their wages from their existing minimum wage up to the hypothetical minimum wage that occurred in their corresponding treatment group that experienced a minimum wage increase. As stated in Campolieti, Fang, and Gunderson (2005), the gap adjustment for both treatment and control groups essentially controls for within-group heterogeneity for both groups. The coefficients from the wage gap methodology are converted to employment effects by multiplying them by the average minimum wage increase of 78 RMB.

To address the issue of unobserved heterogeneity and to control for possible business-cycle effects and for the aging of the sample, we also include an individual fixed-effect and a year fixed-effect in Equations (3) and (4) by exploiting the panel nature of our data:

$$E_{i,t}^{j} = \alpha\, AtRisk_{i,t}^{j} + X_{i,t}\beta + \mu_i + \tau_t + u_{i,t}, \tag{5}$$

$$E_{i,t}^{j} = \alpha[Wagegap_{i,t}^{j} \times AtRisk_{i,t}^{j}] + X_{i,t}\beta + \mu_i + \tau_t + u_{i,t}, \quad (6)$$

where μ_i represents constant, individual-specific heterogeneity and τ_t is the year fixed-effect. As indicated, we estimate Equations (5) and (6) using Linear Probability Models for both the pooled cross-section regressions and the random-effects panel regressions, respectively.[10]

As common in this literature, various low-wage control groups are used to reflect those workers who are in a jurisdiction where there was not a minimum wage increase, but who likely would have been affected by one if it had occurred (i.e., they were working at a wage that was above their own minimum wage but below the hypothetical wage that would result if they received the typical minimum wage increase that occurred in jurisdictions with an increase). For the control groups we provide estimates of these hypothetical wage increases ranging from 20 RMB to 200 RMB above their current minimum wage, which approximates the actual minimum wage increases that occurred in the treatment jurisdictions that increased their minimum wage (listed subsequently in Table 5). As indicated, our preferred control group is those with a hypothetical minimum wage increase of 80 RMB which is close to the 78 RMB that is the average minimum wage increase in our data, and also close to the modal increase of 70 RMB.

5. Results

Direct wage results

Table 3 indicates how the wages of at-risk individuals (i.e., whose wages fell between the old and the new minimum wage and who remain employed after the minimum wage increase) are affected by increases in minimum wages. The wage effects are all statistically significant and of substantial magnitude.

[Table 3 about here]

The direct wage effects increase in going from the pooled estimates of column 1 to the panel estimates of columns 2 to 5 which control for unobservables that can otherwise affect the estimates. This suggests that those at risk who are affected by minimum wages have unobserved characteristics that make them less productive relative to their wage and hence they obtain a large wage gain from the minimum wage once that unobserved productivity is controlled for by the individual fixed-effects. Within the panel regressions, the direct wage effects drop slightly in

moving from controlling only for individual fixed-effects (column 2) to also adding year fixed-effects (column 3), city trends (column 4), and macroeconomic controls (column 5). This highlights the importance of controlling for these factors that can otherwise bias the effect of minimum wages on the wages of those affected by a minimum wage increase.

As broader control groups are added (going down the rows) the direct wage effect decreases (e.g., from 0.529 for the MinWage + 20 control group to 0.396 for the MinWage + 200 control group in column 5). This is expected since when netting out the wage increases that are occurring naturally in the control group, those wage increases are of larger magnitudes for the higher wage groups and this reduces the magnitude of the pure direct wage effect for the treatment group that experienced a wage increase.

Our preferred specification is the panel estimates of the last column 5 (since they included the widest range of controls for unobservables) and our preferred control group is the MinWage + 80 RMB (because that is the group that did not experience a minimum wage increase but is given a hypothetical minimum wage increase close to the average increase of 78 RMB). The coefficient estimate from that preferred specification (column 5) and control group (MinWage + 80) is 0.409. Since the double-log specification is an elasticity estimate this indicates that a 10% increase in the minimum wage gives rise to a 4.1% total increase in their wages. The average minimum wage increase over that period of 14% would therefore be associated with a 5.7% increase in the wages of those potentially affected by the increase.[11] In essence, slightly less than half (41%) of the percent increases in minimum wages is reflected in wage increases for those who are expected to be affected by minimum wage increases in that their wages fell between the old and the new minimum wages. This is a substantial effect for persons "at-risk" in that their wages fell between the old and the new minimum wages since many of those workers would have wages already above the old minimum wage and whose wages would therefore not increase by much. That is why the minimum wage increase is not reflected in the actual wage increases of those at risk by a full 100%. It can also reflect non-compliance.

It is difficult to make comparisons in the literature of the direct wage effect of minimum wages since almost all studies of minimum wages in China focus only on the employment effects. And those that do examine wage effects do not use the at-risk methodology so that comparisons are difficult. For example, Yang and Gunderson (2019) look at the effect on earnings, but their analysis is based on monthly earnings for migrant workers and ours is based

on wages and largely excludes migrant workers. They find that the minimum wage increases the earnings of both males and females. However, males tend not to experience an adverse employment effect because part of the cost increase is offset by employers increasing their monthly hours of work, while hours of work do not increase for females, so they experience an adverse employment effect.

Overall, our results indicate that minimum wage increases do seem to have a substantial effect on the wages of those whose wages are potentially affected by the minimum wage increase, raising their wages by slightly less than half (41%) of the minimum wage increases. This suggests that minimum wage increases have their intended effect of raising the wages of otherwise low-wage workers who retain their jobs. We next turn to see if they also have indirect spillover effects on the wages of workers just above the minimum wage. Then we turn to determine if minimum wages have the unintended consequence of reducing the employment probability of workers who are directly affected by the minimum wage.

Wage spillover results

Table 4 gives our wage spillover results based on estimating equation (2). Since these are double-log specifications, the coefficient on the minimum wage term is an elasticity estimate. It indicates that a 10% increase in the minimum wage would give rise to a statistically significant 0.28% (i.e., about one-quarter of 1%) increase in the wages of those in the spillover category who earn between the new minimum wage and 20 RMB above the minimum wage and who are in a "treatment" jurisdiction that experienced a minimum wage increase, compared to those in that same spillover category but who are in a control jurisdiction that did not experience a minimum wage increase. Since the average minimum wage increase was 14%, this suggests that the average minimum wage increase gives rise to a 0.39% increase in wages for those in that first spillover category. Similar size spillover effects prevail for the next two spillover categories, after which the effects drop substantially and are statistically insignificant. The fact that wage spillover effects are confined to those just above the new minimum wage is expected for reasons discussed previously.

[Table 4 about here]

Overall, statistically significant but quantitatively very small positive wage spillover effects prevail for those who earn up to 60 RMB above the new minimum wage. The spillover wage effects are so small, however, that the reasonable conclusion is that minimum wage effects are largely confined to the wages of those whose wages are *directly* affected by the minimum wage increase in that they fall between the old and the new minimum wages.

Effects on the probability of remaining employed

Table 5 illustrates the employment effect of the expected wage increase for the at-risk group whose wages are potentially affected by the minimum wage increase, based on estimating equations (3) to (6). As outlined previously, the gap measure is the difference between the individual's actual wage and the new minimum wage if the worker is at-risk in that the wage falls between the old and new minimum wages, and is set to zero for those not bound by the new minimum.

[Table 5 about here]

The results of Table 5 indicate that minimum wage increases are associated with statistically significant reductions in the probability of remaining employed across all specifications and across all control groups. Our preferred specification is based on the wage gap methodology because the wage gap methodology takes account of the actual wage increase induced by the minimum wage increase. Our preferred specification is also based on the panel estimates because they control for individual and year fixed-effects as well as city-specific time trends and macroeconomic factors. That preferred specification based on the wage gap methodology and the panel estimates is given in column 4 of Table 5. Within that column, our preferred control group is the MinWage + 80 RMB because that is the group that did not experience a minimum wage increase but is given a hypothetical minimum wage increase close to the average increase of 78 RMB. Based on that preferred specification and control group, the minimum wage increases that occurred over that time period are associated with a 0.028 reduction in the probability of being employed in the subsequent period. This is a fairly substantial effect, being a 3.1% reduction relative to the average probability of being employed of 0.900.

Because the at-risk methodology deals with the probability of transitioning from employment to non-employment it is difficult to make comparisons to other studies of China that use different

methodologies. As reviewed in Long and Yang (2016) and Wang and Gunderson (2018) the existing evidence for China is mixed, in part reflecting different datasets, data aggregations, methodologies, time periods, and regions.[12] Our results of an adverse employment effect, however, are consistent with those of Ding (2010), Wang and Gunderson (2011), Ni et al. (2011), Fang and Lin (2015), Long and Yang (2016), and Yang and Gunderson (2019), at least for subsets of the economy that tend to be subject to more competitive market forces.

Our preferred estimate of the adverse employment effect is fairly similar across the different estimation procedures and it is in the mid-range of the adverse employment effects across the different control groups. Based on the different specifications and control groups, the adverse employment effects from the minimum wage increases tend to range from a 2 to 4 percentage point reduction in the probability of being employed, with a 2.8 percentage point reduction being our preferred estimate. Such adverse employment effects are consistent with our previous wage increase estimates since there should be no adverse employment effect if there were no wage increases. That is, we find complementary results for both wage increases and adverse employment effects.

Placebo test

As indicated previously in endnote 2, we also conducted a placebo test by doing the analysis separately for the 2002–03 period, the two years of data that was available prior to the 2004 reforms. The expectation would be for little or no impact of minimum wages prior to the 2004 reforms to the extent that enforcement would be weak in the pre-reform period. Our results are presented in Appendix Tables 1, 2, and 3, available on-line and on request. The results are consistent with the expectations from such a placebo test in that the effects are generally statistically insignificant for all specifications for all three outcomes (employment, wage spillover, and wage outcomes) in the pre-2004 period when effects were expected to be minimal.

6. Conclusions

Our empirical work contributes to the minimum wage literature on China in a number of important ways. First, the empirical analysis spans the years 2004 to 2009 so we are able to take advantage of the substantial variation in both the magnitude and frequency of minimum wage changes that have occurred in China since its new minimum wage regulations in 2004. Second,

the data is longitudinal so we are able to use individual and year fixed-effect panel estimation procedures to better control for unobserved heterogeneity that can otherwise contaminate the estimates of minimum wage impacts. Third, we are able to merge county-level minimum wage data (which is the level where minimum wages are set) with individual-level data (which is the level where wage and employment effects occur). Fourth, the individual-level data enables us to use both the "at-risk" and "gap" methodologies for estimating wage and employment effects. Fifth, we estimate both the wage and employment effects of minimum wage increases which provide corroborating evidence since positive wage effects and negative employment effects would go hand-in-hand. Sixth, we estimate wage spillovers to see if minimum wages have ripple effects on the wages of those whose wages are above the new minimum wage and who may be indirectly affected.

Due to the survey design, our data set, however, does not include the large number of low-paid migrant workers who do not have an urban household registration (hukou), and those numbers were substantial in the 2004–09 period. As such, our wage and employment effects are likely conservative estimates and would be larger if all migrant workers were included in the data. Adverse employment effects for migrant workers are found in Wang and Gunderson (2011) for non-state-owned enterprises that disproportionately employ migrant workers, and in Yang and Gunderson (2019) for female migrant workers.

The wage results indicate that minimum wage increases have their intended effect of raising the wages of otherwise similar low-wage workers, raising their wages by 41% of the minimum wage increases. They do not raise them by the full minimum wage increase because many were already working at a wage above the old minimum wage but below the new minimum. Also, there may not be full compliance.

The employment results indicate that minimum wage increases also have the unintended consequence of reducing their probability of being employed. Based on a variety of different specifications and control groups, the adverse employment effects from the minimum wage increases that occurred over the period are all statistically significant and fairly substantial in magnitude. They range from a 2 to 4 percentage point reduction in the probability of being employed, with a 2.8 percentage point reduction being our preferred estimate. This is a fairly substantial effect, being a 3.1% reduction relative to the average probability of being employed

of 0.900. Such adverse employment effects also corroborate our wage increase estimates since there should be no adverse employment effect if there were no wage increases.

We find statistically significant but quantitatively small positive wage spillover effects that are confined to groups of workers whose wages are only slightly above the new minimum wage. The spillover wage effects are so small, however, that the reasonable conclusion is that minimum wage effects are largely confined to the wages of those whose wages are *directly* affected by the minimum wage increase in that they fall between the old and the new minimum wages.

Clearly, China faces a trade-off that is typical in economics. Minimum wages can raise the wages of low-wage workers in China, but at the expense of reducing their employment probability. There is no such thing as a free lunch for raising minimum wages in China.

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Table 1. Minimum wages across regions in China, 2004–09

Province	2004		2005		2006		2007		2008		2009	
	mean	s.d	mean	s.d	mean	s.d	mean	s.d	mean	s.d	mean	s.d
East												
Beijing	586.3	0.0	624.3	0.0	667.2	0.0	717.1	0.0	758.5	0.0	800.0	0.0
Tianjin	565.4	7.4	616.3	9.7	705.7	9.5	751.3	9.1	792.0	2.2	820.0	0.0
Hebei	423.5	31.7	511.2	31.2	509.8	32.0	505.0	41.5	573.8	52.2	610.8	62.6
Shandong	400.9	45.2	489.4	64.2	495.8	66.5	513.2	79.2	589.8	95.2	594.9	96.1
Shanghai	679.4	0.0	735.3	0.0	776.4	0.0	816.2	0.0	922.1	0.0	960.0	0.0
Jiangsu	479.1	81.7	507.7	87.7	582.7	106.3	637.9	94.1	670.3	103.3	678.5	107.4
Zhejiang	552.5	51.9	618.1	65.3	677.2	66.0	730.1	75.3	780.5	80.5	851.8	89.5
Fujian	364.9	52.9	400.6	61.0	471.3	75.2	541.1	80.9	564.9	79.5	569.8	80.2
Guangdong	415.4	72.9	476.8	93.2	513.7	100.2	557.0	99.2	592.7	94.0	620.9	98.8
Hainan	403.1	64.1	427.3	67.6	464.8	66.6	491.0	63.8	510.6	60.4	515.0	60.9
Northeast												
Liaoning	324.8	60.5	405.7	45.6	442.4	53.8	499.5	64.7	567.4	71.4	573.4	71.5
Jilin	363.6	23.1	357.9	22.7	443.0	32.3	618.3	39.3	585.6	37.2	590.6	37.5
Heilongjiang	324.6	34.7	319.5	34.2	417.7	50.8	450.5	58.6	470.3	61.4	474.3	61.9
Central												
Shanxi	451.0	70.5	494.3	45.5	495.3	44.8	513.3	42.9	553.4	43.2	626.7	51.2
Henan	289.4	32.2	309.1	32.2	376.2	43.1	400.0	41.1	492.2	57.0	496.5	57.5
Jiangxi	284.8	23.2	352.6	25.1	352.8	24.8	460.7	27.2	474.7	34.3	478.8	34.6
Anhui	350.6	29.1	367.0	32.3	381.8	35.9	431.8	48.6	433.6	49.1	437.3	49.5
Hubei	312.5	50.3	355.1	53.3	359.5	53.8	432.7	55.7	466.3	60.6	527.3	72.5
Hunan	389.9	33.5	416.4	34.0	449.2	33.1	476.5	32.8	507.7	32.1	547.5	37.9
West												
Inner Mongolia	387.6	17.8	432.0	18.1	437.4	29.0	452.3	62.0	530.3	65.0	534.9	65.6
Guangxi	371.8	16.9	425.3	42.4	429.8	43.3	446.0	45.7	504.3	51.4	554.7	57.4
Chongqing	384.6	27.8	405.9	30.2	445.6	38.8	514.9	58.5	572.2	63.9	577.1	64.4
Sichuan	304.0	43.5	314.7	62.7	360.7	56.6	458.7	50.9	493.2	61.8	497.5	62.4
Guizhou	348.1	26.9	384.4	35.5	416.2	37.2	522.3	41.9	578.0	39.7	583.0	40.0
Yunnan	342.4	28.0	405.3	34.2	440.1	34.3	460.1	34.9	543.8	47.1	548.5	47.5
Tibet	343.1	3.5	537.5	21.8	529.7	21.5	507.0	20.6	702.5	39.0	708.6	39.3
Shaanxi	309.8	26.1	394.2	28.3	493.9	35.5	489.4	38.8	523.0	36.8	527.5	37.1
Gansu	343.2	13.5	337.8	13.3	352.2	20.9	371.3	40.9	484.6	40.4	535.9	41.4
Qinghai	297.4	17.0	384.3	16.7	436.1	12.7	472.4	8.7	539.0	8.3	591.3	8.3
Ningxia	385.5	26.5	382.4	26.5	436.7	30.2	458.5	29.7	516.0	28.1	520.5	28.4
Xinjiang	365.7	37.9	374.4	37.9	408.3	40.8	479.8	43.1	561.4	55.8	566.3	56.3

Notes: Minimum wages have been calculated as time-weighted average values based on county-level minimum wage data. Values have been accounted for inflation to the price level in 2009 using the urban CPI at the province level developed by Brandt and Holz (2006). The updated indices are obtained from http://carstenholz.people.ust.hk/SpatialDeflators.html.

Table 2. Summary statistics of at-risk and not-at-risk employed individuals, 2004–09

Variable	At-risk Mean	Not-at-risk Mean	Diff.
Employment probability (DV)	0.900	0.936	-0.037***
	[0.301]	[0.244]	(0.006)
Age	41.115	41.892	-0.777***
	[10.018]	[9.308]	(0.188)
Male	0.375	0.555	-0.179***
	[0.484]	[0.497]	(0.009)
Years of schooling	11.237	12.709	-1.472***
	[2.666]	[2.782]	(0.050)
Married with spouse present	0.853	0.896	-0.043***
	[0.354]	[0.306]	(0.007)
Han ethnicity	0.976	0.971	0.004
	[0.154]	[0.167]	(0.003)
Local hukou	0.971	0.975	-0.004
	[0.167]	[0.156]	(0.003)
Work experience (year)	23.838	23.158	0.679***
	[10.995]	[10.306]	(0.207)
Years of residence	33.691	31.732	1.959***
	[14.581]	[14.902]	(0.275)
Wages (monthly RMB)	488.513	1781.093	-1292.580***
	[342.482]	[1431.723]	(10.032)
Minimum wage (monthly RMB)	543.50	543.50	-
	[146.61]	[146.61]	-
Wage gap (monthly RMB)	54.997	-1237.598	-1182.601***
	[46.874]	[1332.542]	(9.426)
Educational attainment (%)			
Elementary school or no schooling	4.49	2.54	
Junior high school	34.01	21.96	
High school	35.53	25.32	
Vocational school	10.04	12.71	
Junior college	12.19	24.11	
College or above	3.73	13.37	
Occupation (%)			
Public sector	4.90	11.86	
Technical job	2.82	14.94	
Clerical and related staff	21.63	30.61	
Production, transportation, operators	9.91	15.52	
Business or service job	39.07	9.77	
Agricultural job	14.21	6.84	
Other	7.46	10.46	
Industry (%)			
Mining	1.80	3.17	

Manufacturing	21.35	22.60
Power production and supply	1.28	3.54
Construction	2.81	3.12
Transportation and postal service	4.49	7.33
Information technology	1.71	2.14
Wholesale and retail sales	19.02	9.66
Hotel and restaurant	4.90	2.43
Banking and finance	1.35	2.95
Real estate	2.14	1.88
Leasing and commercial service	1.55	1.53
Scientific Research	0.69	2.08
Environment and public facility	1.03	1.33
Housekeeping	21.14	8.86
Education	2.73	7.20
Health care	2.54	4.67
Sports and entertainment	1.15	1.69
Public service	8.30	13.82
Percent of individuals with		
1 obs.	45.27	53.04
2 obs.	38.15	33.89
3 obs.	13.48	10.19
4 obs.	2.99	2.70
5 obs.	0.08	0.12
6 obs.	0.04	0.07
Number of observations	2,879	130,261

Note: *** statistically significant at the 1% level. At-risk individuals are workers whose monthly wages in the previous year (*t*-1) are less than the new minimum (*t*) but no less than the old minimum in the year *t*-1., i.e., $\mathrm{MW}_{t-1} \leq \mathrm{Wage}_{t-1} < \mathrm{MW}_{t}$ Wages and minimum wages have been adjusted for inflation (2009 base year) and accounted for the differing living costs among provinces by applying the PPP-adjusted deflator developed by Brandt and Holz (2006). The means of wages and wage gaps are calculated at the individual level, whereas the average of minimum wages is calculated using the new minimum at the county level from the 16 provinces. Standard deviations are in brackets and standard errors are in parentheses.

Table 3. Effect of minimum wage changes on wages of at-risk individuals, 2004–09

Dep. variable: log wage		Pooled OLS	Fixed-effects panel regressions			
Control group	*N*	(1)	(2)	(3)	(4)	(5)
MinWage+20	5678	0.345***	0.782***	0.764***	0.651***	0.529***
		(0.035)	(0.028)	(0.034)	(0.049)	(0.046)
MinWage+40	6381	0.266***	0.707***	0.682***	0.586***	0.463***
		(0.029)	(0.031)	(0.039)	(0.060)	(0.052)
MinWage+60	7455	0.233***	0.666***	0.623***	0.555***	0.433***
		(0.027)	(0.031)	(0.040)	(0.068)	(0.060)
MinWage+80	8990	0.220***	0.616***	0.572***	0.524***	0.409***
		(0.026)	(0.031)	(0.041)	(0.078)	(0.070)
MinWage+100	10140	0.222***	0.591***	0.558***	0.514***	0.401***
		(0.026)	(0.032)	(0.040)	(0.080)	(0.073)
MinWage+120	11503	0.223***	0.577***	0.542***	0.504***	0.393***
		(0.026)	(0.031)	(0.039)	(0.081)	(0.074)
MinWage+140	11979	0.228***	0.581***	0.539***	0.507***	0.398***
		(0.026)	(0.030)	(0.039)	(0.084)	(0.078)
MinWage+160	13208	0.236***	0.583***	0.535***	0.508***	0.400***
		(0.025)	(0.030)	(0.038)	(0.084)	(0.079)
MinWage+180	15215	0.240***	0.577***	0.537***	0.505***	0.398***
		(0.025)	(0.030)	(0.038)	(0.085)	(0.080)
MinWage+200	16436	0.247***	0.584***	0.536***	0.504***	0.396***
		(0.026)	(0.029)	(0.037)	(0.084)	(0.080)
Individual fixed-effects			Yes	Yes	Yes	Yes
Year fixed-effects		Yes		Yes	Yes	Yes
City trends		Yes			Yes	Yes
Macroeconomic controls		Yes				Yes

Note: *** statistically significant at the 1% level. Cluster-robust standard errors at the county level are in parentheses. Clustering at the individual-level does not alter the significance level of the estimates and is hence not reported here. The pooled OLS regression has controlled for individual characteristics—gender, years of schooling, marital status, work experience, work experience squared, ethnicity, hukou status, occupation, and industry—as well as year fixed effects, province fixed-effects, city trends and macro controls for GDP per capita and foreign direct investment at the city level. The fixed effects panel regressions do not include variables that are time-invariant such as gender and ethnicity. The full estimation results are available on request. For control groups (which do not experience minimum wage increases), MinWage+XXX denotes minimum wage (MinWage) plus XXX Chinese dollar (RMB) above the minimum. For our preferred control group (MinWage + 80), the ratio of at-risk workers to total workers (at-risk and not-at-risk) is 0.512, indicating that the treatment and control groups are of about equal size.

Table 4. Wage spillover estimates by wage category, 2004–09

Dep. variable: log wage Treatment and control groups	Total obs.	Coefficients (St. Errors)
New MinWage < Wage ≤ New MinWage + 20	898	0.028***
		(0.009)
New MinWage + 20 < Wage ≤ New MinWage + 40	876	0.030**
		(0.015)
New MinWage + 40 < Wage ≤ New MinWage + 60	1005	0.025*
		(0.013)
New MinWage + 60 < Wage ≤ New MinWage + 80	933	0.008
		(0.014)
New MinWage + 80 < Wage ≤ New MinWage + 100	986	0.016
		(0.011)
New MinWage + 100 < Wage ≤ New MinWage + 120	1022	0.010
		(0.015)
New MinWage + 120 < Wage ≤ New MinWage + 140	894	0.014
		(0.014)
New MinWage + 140 < Wage ≤ New MinWage + 160	1118	0.016
		(0.010)
New MinWage + 160 < Wage ≤ New MinWage + 180	961	-0.003
		(0.006)
New MinWage + 180 < Wage ≤ New MinWage + 200	1002	0.015
		(0.010)

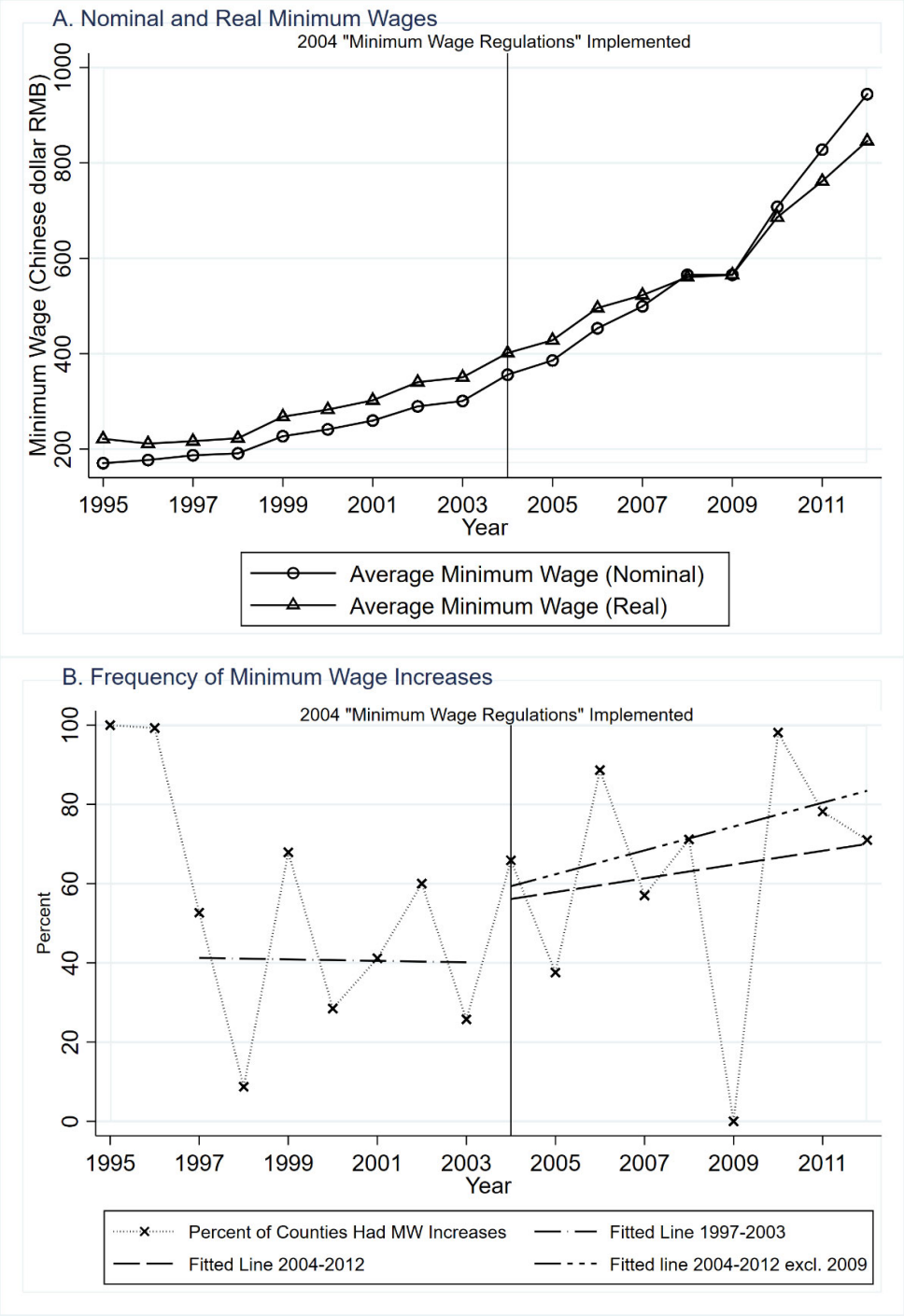
Note: *** statistically significant at the 1% level; ** at the 5% level; * at the 10% level. Cluster-robust standard errors at the county level are in parentheses. Clustering at the individual-level does not alter the significance level of the estimates are hence are not reported here. All regressions have controlled for individual characteristics as well as year fixed-effects, province fixed-effects, and macroeconomic controls for GDP per capita and FDI at the city level. The coefficient estimates are the coefficients for [*MW*MWAdj*] in equation 2.

Table 5. Marginal Effects of minimum wage changes on employment probability of at-risk individuals, 2004–09 (Mean dependent variable of probability of being employed =0.900)

		At-risk Methodology		Wage Gap Methodology			
		Linear Probability Model		Linear Probability Model			
		Pooled	Panel random-effects	Pooled		Panel random-effects	
		(1)	(2)	(3)		(4)	
Control Group	Total obs.	Empl. Effect	Empl. Effect	Estimated Coefficient	Empl. Effect	Estimated Coefficient	Empl. Effect
MinWage+20	2,443	-0.033***	-0.028***	-0.000497***	-0.039	-0.000479***	-0.037
		(0.009)	(0.008)	(0.000064)		(0.000063)	
MinWage+40	3,082	-0.026***	-0.025***	-0.000444***	-0.035	-0.000432***	-0.034
		(0.009)	(0.007)	(0.000060)		(0.000059)	
MinWage+60	3,781	-0.022***	-0.019***	-0.000408***	-0.032	-0.000392***	-0.031
		(0.008)	(0.007)	(0.000057)		(0.000056)	
MinWage+80	4,557	-0.021***	-0.019***	-0.000382***	-0.030	-0.000365***	-0.028
		(0.008)	(0.006)	(0.000054)		(0.000053)	
MinWage+100	5,268	-0.021***	-0.019***	-0.000363***	-0.028	-0.000350***	-0.027
		(0.007)	(0.006)	(0.000053)		(0.000052)	
MinWage+120	6,089	-0.020***	-0.017***	-0.000352***	-0.027	-0.000336***	-0.026
		(0.007)	(0.006)	(0.000051)		(0.000051)	
MinWage+140	6,814	-0.020***	-0.017***	-0.000343***	-0.027	-0.000328***	-0.026
		(0.006)	(0.005)	(0.000050)		(0.000049)	
MinWage+160	7,650	-0.022***	-0.019***	-0.000337***	-0.026	-0.000322***	-0.025
		(0.006)	(0.005)	(0.000049)		(0.000049)	
MinWage+180	8,377	-0.023***	-0.019***	-0.000332***	-0.026	-0.000319***	-0.025
		(0.006)	(0.005)	(0.000049)		(0.000048)	
MinWage+200	9,150	-0.023***	-0.019***	-0.000327***	-0.026	-0.000314***	-0.024
		(0.006)	(0.004)	(0.000048)		(0.000048)	

Note: *** statistically significant at the 1% level. Cluster-robust standard errors at the county level are in parentheses. Clustering at the individual-level does not alter the significance level of the estimates and is hence not reported here. All Models have controlled for individual characteristics, GDP per capita and FDI at the city level. MinWage+XXX denotes minimum wage (MinWage) plus XXX Chinese dollar (RMB) above the minimum. The increase in the minimum wage ranges from 5 to 260 RMB between 2004 and 2009 and the mean increase is 78 RMB. The employment effect for the at-risk methodology is the estimated coefficient of the at-risk dummy variable (*AtRisk*) from the linear probability model (equation 5); whereas the employment effect for the wage gap methodology is the estimated coefficient times the mean increase of minimum wages (78 RMB) from equation 6.

Figure 1. Average Minimum Wage (Panel A) and Frequencies of Increases (Panel B) in China, 1995–2012



Average minimum wages have been calculated as time-weighted average values based on county-level minimum wage data. Real minimum wages have been adjusted for inflation and shown at 2009 Chinese dollar values using the official urban CPI at the province level which applied to the 1990 urban basket (priced at 1990 urban prices) developed by Brandt and Holz (2006). The updated indices are obtained from http://carstenholz.people.ust.hk/SpatialDeflators.html. The number of counties ranges from 1850 to 2370 each year over the 1995–2012 period in our data. There were no minimum wage increases over the country in 2009 due to the Great Recession.

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Appendix Table 1. Marginal Effects of minimum wage changes on employment probability of at-risk individuals during the pre-2004 period, 2002 and 2003

		At-risk Methodology	Wage Gap Methodology	
		Linear Probability Model	Linear Probability Model	
		Pooled	Pooled	
		(1)	(2)	
Control Group	Total obs.	Employment Effect	Estimated Coefficient	Employment Effect
MinWage+20	818	-0.018	-0.000362	-0.018
		(0.012)	(0.000226)	
MinWage+40	991	-0.010	-0.000337	-0.017
		(0.012)	(0.000209)	
MinWage+60	1,192	-0.016	-0.000299	-0.015
		(0.011)	(0.000186)	
MinWage+80	1,575	-0.014	-0.000218	-0.011
		(0.011)	(0.000155)	
MinWage+100	2,056	-0.006	-0.000182	-0.009
		(0.011)	(0.000133)	
MinWage+120	2,336	-0.007	-0.000170	-0.009
		(0.011)	(0.000128)	
MinWage+140	2,844	-0.005	-0.000161	-0.008
		(0.010)	(0.000126)	
MinWage+160	3,346	-0.008	-0.000147	-0.007
		(0.009)	(0.000123)	
MinWage+180	4,089	-0.009	-0.000135	-0.007
		(0.009)	(0.000118)	
MinWage+200	4,860	-0.010	-0.000131	-0.007
		(0.009)	(0.000116)	

Note: Cluster-robust standard errors at the county level are in parentheses. Clustering at the individual-level does not alter the significance level of the estimates and is hence not reported here. All Models have controlled for individual characteristics, GDP per capita and FDI at the city level. MinWage+XXX denotes minimum wage (MinWage) plus XXX Chinese dollar (RMB) above the minimum. The increase in the minimum wage ranges from 5 to 170 RMB between 2002 and 2003 and the mean increase is 50 RMB. The employment effect for the at-risk methodology is the estimated coefficient of the at-risk dummy variable (*AtRisk*) from the linear probability model (equation 5); whereas the employment effect for the wage gap methodology is the estimated coefficient times the mean increase of minimum wages (50 RMB) from equation 6.

Appendix Table 2. Wage spillover estimates by wage category during the pre-2004 period, 2002 and 2003

Dep. variable: log wage Treatment and control groups	Total obs.	Coefficients (St. Errors)
New MinWage < Wage ≤ New MinWage + 20	348	0.007***
		(0.002)
New MinWage + 20 < Wage ≤ New MinWage + 40	365	0.001
		(0.001)
New MinWage + 40 < Wage ≤ New MinWage + 60	352	-0.001
		(0.002)
New MinWage + 60 < Wage ≤ New MinWage + 80	344	-0.000
		(0.001)
New MinWage + 80 < Wage ≤ New MinWage + 100	325	-0.000
		(0.001)
New MinWage + 100 < Wage ≤ New MinWage + 120	331	0.002
		(0.002)
New MinWage + 120 < Wage ≤ New MinWage + 140	310	0.000
		(0.002)
New MinWage + 140 < Wage ≤ New MinWage + 160	271	-0.001
		(0.001)
New MinWage + 160 < Wage ≤ New MinWage + 180	254	0.002
		(0.002)
New MinWage + 180 < Wage ≤ New MinWage + 200	226	-0.000
		(0.001)

Note: *** statistically significant at the 1% level. Cluster-robust standard errors at the county level are in parentheses. Clustering at the individual-level does not alter the significance level of the estimates are hence are not reported here. All regressions have controlled for individual characteristics as well as year fixed-effects, province fixed-effects, and macroeconomic controls for GDP per capita and FDI at the city level. The coefficient estimates are the coefficients for [*MW*MWAdj*] in equation 2.

Appendix Table 3. Effect of minimum wage changes on wages of at-risk individuals during the pre-2004 period, 2002 and 2003

Dep. variable: log wage		Pooled OLS	Fixed-effects panel regressions			
Control group	*N*	(1)	(2)	(3)	(4)	(5)
MinWage+20	1099	0.632***	0.371*	0.373*	0.185	0.135
		(0.062)	(0.200)	(0.193)	(0.128)	(0.084)
MinWage+40	1517	0.561***	0.251**	0.261**	0.344***	0.157
		(0.059)	(0.126)	(0.121)	(0.137)	(0.119)
MinWage+60	1979	0.551***	0.201*	0.207**	0.284	0.174
		(0.056)	(0.103)	(0.103)	(0.178)	(0.171)
MinWage+80	2630	0.556***	0.238***	0.245***	0.223	0.104
		(0.054)	(0.087)	(0.085)	(0.202)	(0.192)
MinWage+100	3218	0.550***	0.250***	0.254***	0.275	0.180
		(0.053)	(0.082)	(0.081)	(0.169)	(0.167)
MinWage+120	3821	0.544***	0.311***	0.297***	0.373**	0.264
		(0.052)	(0.081)	(0.075)	(0.171)	(0.170)
MinWage+140	4342	0.554***	0.312***	0.296***	0.305*	0.135
		(0.052)	(0.075)	(0.067)	(0.169)	(0.154)
MinWage+160	4971	0.551***	0.353***	0.325***	0.272	0.116
		(0.051)	(0.078)	(0.070)	(0.171)	(0.162)
MinWage+180	5544	0.563***	0.335***	0.300***	0.273	0.145
		(0.049)	(0.080)	(0.074)	(0.207)	(0.184)
MinWage+200	6093	0.562***	0.307***	0.266***	0.146	0.056
		(0.047)	(0.087)	(0.078)	(0.169)	(0.153)
Individual fixed-effects			Yes	Yes	Yes	Yes
Year fixed-effects		Yes		Yes	Yes	Yes
City trends		Yes			Yes	Yes
Macroeconomic controls		Yes				Yes

Note: *** statistically significant at the 1% level; ** at the 5% level; * at the 10% level. Cluster-robust standard errors at the county level are in parentheses. Clustering at the individual-level does not alter the significance level of the estimates and is hence not reported here. The pooled OLS regression has controlled for individual characteristics—gender, years of schooling, marital status, work experience, work experience squared, ethnicity, hukou status, occupation, and industry—as well as year fixed effects, province fixed-effects, city trends, and macro controls for GDP per capita and foreign direct investment at the city level. The fixed effects panel regressions do not include variables that are time-invariant such as gender and ethnicity. The full estimation results are available on request. For control groups (which do not experience minimum wage increases), MinWage+XXX denotes minimum wage (MinWage) plus XXX Chinese dollar (RMB) above the minimum. For our preferred control group (MinWage + 80), the ratio of at-risk workers to total workers (at-risk and not-at-risk) is 0.512, indicating that the treatment and control groups are of about equal size.

Endnotes

[1] For example, Ni, Wang, and Yao (2011) and Wang and Gunderson (2011, 2012) use provincial-level data from the Chinese statistic yearbooks; Fang and Lin (2015) use aggregated county-level data calculated from household surveys; Ding (2009) uses an employment survey in Beijing, and Ding (2010) uses a firm survey in Fujian and Guangdong provinces.

[2] As described subsequently, our survey data is from 2002 to 2009 and our minimum wage data is from 1994 to 2012. For our empirical analysis, we use the data from 2004–2009, after the 2004 Minimum Wage Regulation in China. At the suggestion of the referees, we also conducted a placebo test by doing the analysis separately for the two years of data, 2002 and 2003, which was available prior to the 2004 reforms. The expectation would be for little or no impact of minimum wages prior to the 2004 reforms to the extent that enforcement would be weak in the pre-reform period. Panel regressions could not be estimated for the employment outcome because we only have one year of data, 2003. The year 2002 cannot be used for the employment outcome because we do not have employment status at year t-1 (which is 2001). Our results are presented in Appendix Tables 1, 2, and 3, available on-line and on request. The results are consistent with the expectations from such a placebo test. Specifically, the employment effects are all statistically insignificant (Appendix Table 1), as are the wage spillover effects except for a very small effect for the +20 category (Appendix Table 2) and for all of the wage effects in the final specification with controls (Appendix Table 3).

[3] The UHS is not publicly available. The National Bureau of Statistics of the People's Republic of China, however, allows limited access to the microdata for up to 16 provinces under certain conditions for academic research. Due to increased concerns on confidentiality and social stability (for instance, using the UHS to calculate sensitive indicators such as unemployment rates), the bureau has stopped granting access to the microdata. As a result, the UHS data are no longer accessible starting in 2010. The 16-province sample (Heilongjiang, Liaoning, Gansu, Beijing, Shanxi, Shanghai, Shandong, Jiangsu, Anhui, Jiangxi, Hubei, Henan, Guangdong, Chongqing, Sichuan, and Yunnan) includes most economically important provinces in China, containing 65% of the total population covering 60% of the counties and 35% of GDP in the country (National Bureau of Statistics of China 2010). A comparison of the descriptive statistics from the UHS with 2005 Census data for all provinces indicate that the UHS sample is representative (results available on request).

[4] Therefore, the UHS contains some migrant households with local residency; however, most migrants working in urban areas without an urban household registration (hukou) are not included in the surveys. Consequently, our analysis focuses on workers with urban residency and the results should be interpreted with that caveat in mind. Since migrant workers are generally very low-paid relative to urban workers, our wage and employment effects are likely conservative estimates and would be larger if migrant workers without an urban hukou were included in the data. Since the period of 2004–09 witnessed significant numbers of rural to urban migrants, many more workers would have been affected if those migrant workers without an urban hukou were included in the data.

[5] For example, if the adjustment in a particular county and a particular year occurs on June 1st, the figure for that year and county is the average of the old and the new minimum wages, with weights of 5/12 and 7/12, respectively.

[6] We define the control group as both (1) workers whose wages fall in the same range as the treatment group but live in a different county without a minimum wage increase and (2) workers who work in the same county as the treatment group but earn MinWage + XXX. (Note: (1) applies to estimations of the wage and employment effects; (2) only applies to the estimation of wage spillover effects.)

[7] About 7.6% of our data were below the old minimum wage. Such low wages can be the result of measurement or response errors or illegal activity or non-compliance or other unusual circumstances. If such low-wage workers were not in compliance in the old regime, they are unlikely to be in compliance in the new regime. As is conventional in the literature using the at-risk methodology, we have excluded those whose wages were below the old minimum wage from the estimations.

[8] The at-risk methodology can assess the effects of the minimum wage increases only on the transition from employment to non-employment, referred to as the dis-employment effect. It cannot estimate the effects of the minimum wage on transitions from non-employment to employment because there is no wage information on non-employed persons to define an at-risk group. To the extent that a minimum wage increase will also reduce the probability that a non-employed person can obtain a job and become employed, our estimates would be a conservative estimate of the dis-employment effect.

[9] The results are similar to the marginal effects from a logit or probit model.

[10] Heckman (1981) shows that the fixed-effects logit (or probit) estimator is inconsistent when the number of observations per person is small as in our case. Therefore, we use Linear Probability Estimates for the fixed- and random-effects models and chose the random-effects specifications based on the cluster-robust Hausman tests (Cameron and Trivedi 2005). All cluster-robust Hausman tests with 400 bootstrap replications do not reject the null hypothesis that the random-effects model provides consistent and efficient estimates. The results are available upon request.

[11] The average minimum wage increase is 78 RMB (close to the mode of 70) which is a 14% increase over the monthly minimum wage of $543.5 as indicated in Table 2.

[12] Ding (2010) finds that higher minimum wages in 2007 reduced the employment of urban works by 4.4% and that of migrant workers by 3.9%. Ni et al. (2011) use aggregated province data from 2000 to 2005 and show that minimum wages have no significant adverse effect on employment in the country as a whole, but a significant and substantial negative effect in the more developed and competitive eastern region, with a 10% increase in the minimum wage leading to a 2.3% decrease in employment. Wang and Gunderson (2011) estimate that a 10% increase in the minimum wage gave give rise to a 1.7% reduction in employment of rural migrant workers in the central and western regions over the period 2000 to 2007. In a subsequent study, based on 2003 data for the eastern region of China, Wang and Gunderson

(2012) find minimum wages to have no discernable impact on wages, across all workers, and for any subgroup. Based on the difference-in-difference analysis, they find an adverse employment effect but the effect is statistically insignificant and small in magnitude, likely reflecting the absence of a wage effect and the use of data prior to the 2004 reforms of minimum wage laws. Fang and Lin (2015) use a 16-province urban household survey over the 2004–09 period and estimate employment elasticities for young adults in the range of -0.062 to - 0.156. Using firm-level data for 2004, 2006, and 2008, Long and Yang (2016) find that minimum wage increases led to reductions in fringe benefits as well as the employment of workers with low skills and short-term contracts. Wang and Gunderson (2018) use data from the China Health and Nutrition Survey. Their difference-in-difference and triple differences estimates are statistically insignificant, showing no adverse employment effects on low-skilled workers in less developed and less competitive regions of China. Yang and Gunderson (2019) find an overall positive earnings effect of 6% for migrant workers, and that migrants in jurisdictions that have increased their minimum wages have a probability of being employed that is 14.3 percentage points lower than migrants in jurisdictions that did not increase their minimum wage.