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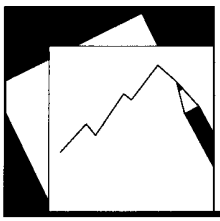

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Minimum Wages and Firm Employment: Evidence from China

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Abstract

This paper provides the first systematic study of how minimum wage policies in China affect firm employment over the 2000-2007 periods. Using a novel dataset of minimum wage regulations across more than 2,800 counties matched with firm-level data, we investigate both the effect of the minimum wage and its policy enforcement tightening in 2004. A dynamic panel (difference GMM) estimator is combined with a "neighbor-pairs-approach" to control for unobservable heterogeneity common to "border counties" that are subject to different minimum wage changes. We show that minimum wage increases have a significant negative impact on employment, with an estimated elasticity of -0.1. Furthermore, we find a heterogeneous effect of the minimum wage on employment which depends on the firm's wage level. Specifically, the minimum wage has a greater negative impact on employment in low-wage firms than in high-wage firms. Our results are robust for different treatment groups, sample attrition correction, and placebo tests.

JEL Classification Numbers: J24; J31; O14; F10; F14

Keywords: China, employment, minimum wages

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Contents

1 Introduction

The rising labor cost in China is a widely discussed topic among policymakers and economists. In the period from 1998 to 2010, the average growth rate of real wages was 13.8 percent, exceeding the real GDP growth rate as well as the growth of labor productivity (Li, Li, Wu, and Xiong, 2012). Among labor market policy tools, the minimum wage policy in China has been considered a major force driving increases in wages and bringing pressure on businesses[1]. As employment hinges on business performance, the minimum wage can raise the income of poorly paid workers, but meanwhile cause some of them to lose their jobs. Empirically, the substantial literature on the minimum wage arrives at little consensus on its impact on employment. While traditional research find that an increase in the minimum wage has a negative impact on teenager and youth employment (Brown, Gilroy, and Kohen, 1982; Brown, 1999), the "New Minimum Wage Research" based on firm surveys often shows that employment responses are negligible or even positive (See the studies cited in Neumark and Wascher, 2007 and Schmitt, 2013).

Our paper contributes to this ongoing debate on the impact of minimum wage on employment. Specifically, we provide evidence on the effect of the minimum wage on firm employment using hand-collected data of China's county minimum wages. In contrast to most of policy studies at China's prefectural level, our paper benefits from significant variation in minimum wages at the county level. The geographic division based on China's counties reduces the size of a geographic unit by ten times compared with the division based on prefectural cities as commonly seen in other research. The county minimum wage is also more closely related to the market condition of a local economy and thus closely related to firm behavior.

To our knowledge, this is the first study to show the effect of minimum wages on employment using a comprehensive data set which tracks firms across China in an industry survey. China's Annual Survey of Industrial Firms provides a representative sample of firm data in the manufacturing sector. For example, this survey in 2004 covers more than 91 percent of China's manufacturing output and 71 percent of manufacturing employment. Considering its share in the national economy and employment, the manufacturing sector is of great significance in China's labor market as main concerns about rising labor cost in China have been related to this sector. Furthermore, the overall wage rate of China's manufacturing sector is also relatively low when compared with the average city wage[2], which makes this sector a pertinent target for policy debates on the minimum wage. The firm data enable us to explore how heterogeneous firms show heterogeneous different responses to minimum wage changes. It is of interest to investigate not only the potentially affected firms, but also other firms to see whether spillover and substitution effects exist. It is of interest to investigate not only the potentially affected firms, but also other firms to see whether spillover and substitution effects exist.

The endogenous nature of government policies poses a challenge in measuring the impact of the minimum wage. Freeman (2010) argues that governments could set minimum wages while considering the risk that they can cause more harm than good. In this regard, governments

[1] For example, see an article "China pushes minimum wage rises" published in *Financial Times*, January 4, 2012.

[2] With the countywide data from the Urban Household Survey, Ge and Yang (2014) shows that the average real wage of the manufacturing sector is 2 percent below that of the whole sample in 2007.

must maintain a balance in order not to draw opposition from local employers. Our results show that among various indicators of the local economy, the setting of minimum wages in China is most closely related to local living costs, growth of GDP, and fixed asset investment (a proxy for future growth potential). It is necessary to explore and control for observable determinants of the minimum wage in the employment estimation because firms are also able to make decisions based on this information.

Furthermore, we match county minimum wages with a novel data set of China's neighbor county-pairs. By pairing each county with its adjacent counties, we focus on the variation within neighbor pairs. The use of geographic proximity pioneered by Card and Krueger (1994) in minimum wage research is particularly helpful for firm studies due to relatively low mobility of employers. To examine the treatment effect of the minimum wage policy, neighbors with smaller size serve better as candidate control groups. Comparing with province or prefecture neighbors, the difference in market conditions between treatment and control regions is substantially smaller, especially for labor market factors, such as labor mobility in China's *Hukou* (household registration) system, which are crucial to our research.

Last but not least, we study a minimum wage policy reform that raised the enforcement intensity in 2004 to test whether this reform changed the impact of the minimum wage on employment. Basu, Chau, and Kanbur (2010) argue that the legislated wage floor and the intensity of enforcement are two indispensable arms of a minimum wage policy[3]. Our research provides evidence to evaluate how well a policy to improve equity was implemented in China and how enforcement tightening enhanced policy impacts.

Our main finding is that the elasticity of minimum wages on firm employment is generally negative. Employment adjustment was one way through which China's firms were able to accommodate themselves to cost hikes in the labor market and stricter policy regulations. The elasticity based on the main sample is statistically significant, and it is still in the middle range with the point estimate of -0.103. Considering that our sample includes almost all of the large manufacturing firms and the underlying labor force is vast, the economic impact of this negative elasticity is large. We find that the rise in enforcement intensity from 2004 onwards started to amplify the negative effect after about one year. The strengthened enforcement led to reduction in employment, which should operate through the channel of raising the wage of low-income employees. The response of firm employment to the minimum wage exhibits strong heterogeneity. Our evidence shows that firms with higher wage and higher profit margins exhibit less negative elasticities of minimum wages[4].

Our results are consistent with recent studies on China's minimum wage policy based on other data and approaches. Wang and Gunderson (2011) show that the minimum wage has negative employment effects in regions with slower growth, and even greater negative effects for

[3]They also find that if enforcement is costly and *ex ante* commitment is not feasible, for a government who is more concerned with efficiency than with distribution, optimal intensity of enforcement leads to the coexistence of non-compliance and a high minimum wage.

[4]Our results provide evidence for the theoretical predictions of labor market models on competition, (dynamic) monopsony and efficiency wage, and labor market search with frictions: Manning (1995); Rebitzer and Taylor (1995); Bhaskar et al. (2002); Lang and Kahn (1998); Burdett and Mortensen (1998); Acemoglu (2001); Flinn (2006). Meer and West (2013) find that increases in the minimum wage reduce employment growth through effects on job creation.

non-state enterprises. Using the data of China's urban household survey, Fang and Lin (2013) find that minimum wage increases have resulted in employment reduction for females, young adults, and less-skilled workers, though no significant effects on males in every age cohort. This paper is also related to the growing literature that reconsiders the impact on firm employment using local controls across US states. Allegretto, Dube, and Reich (2011) and Allegretto, Dube, Reich, and Zipperer (2013) have studied explicitly the lagged effects, wage group dynamics, and shifts in the employment flow. Hirsch, Kaufman, and Zelenska (2011) and Schmitt (2013) show no discernible effect on employment by firm's productivity-enhancing activities with the productivity-competition model. The minimum wage policy of China provides new opportunities to evaluate the design and enforcement of labor market policy in emerging market countries, an issue which is also explored in Bell (1997), Harrison and Leamer (1997), Lemos (2004), and Lemos (2009).

We discuss China's minimum wage policy in the next section. The remainder of our paper is structured as follows. We present the theoretical background relating to labor market competition and monopsony, and its implication for the minimum wage in Section 3. We describe the firm-level data and minimum wage data as well as the other regional macro variables in Section 4. We present our empirical strategy for the minimum wage determination and firm employment estimation in Section 5. In Section 6, we show and discuss detailed results on average effects of minimum wage hikes, the effects over years, and heterogeneous effects for different kinds of firms. In section 7, we provide robustness checks with different samples of neighbor county pairs and sample attrition correction. Section 8 concludes.

2 Institution Background: Minimum Wage in China

2.1 Evolution of China's Minimum Wage Policy

In early 1984, during the early phase of its economic reform, China approved the International Labor Organization (ILO)'s *Minimum Wage-Fixing Machinery Convention* (1928). In July 1994 the Labor Law stated a requirement to implement a system of guaranteed minimum wages. According to Article 48 of the Labor Law, firms were specifically required to comply with local minimum wage regulations. Provincial governments are authorized to set their own minimum wage standards. The levels of minimum wages are not universally same within a province in that cities and counties can negotiate their local minimum wages with higher authorities (Casale and Zhu, 2013 and Su and Wang, 2014). Before 2003, the adjustment of minimum wages had been less frequent than the following years. In the year 1998 during the Asia financial crisis, only one fifth of all counties adjusted their minimum wages.

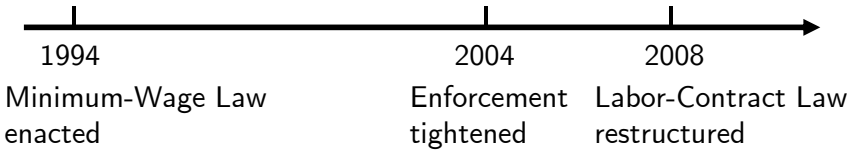
As China had advanced in its market reforms when it joined the WTO in 2001, the framework of minimum wage regulations became outdated and in need of change. In March 2004, the Ministry of Labor[5] issued a new directive that established a more comprehensive coverage of minimum wage standards and increased non-compliance penalties. In particular, this reform

[5] As China's leading institution that governs minimum wage regulations, the Ministry of Labor merged with the Ministry of Human Resources and was renamed the Ministry of Human Resources and Social Security in 2008.

emphasized the following major changes: (1) an extension of coverage to town-village enterprises and self-employed business; (2) creation of new standard for hourly minimum wages; (3) an increase in the penalty for violators from 20%-100% to 100%-500% of the wage owed; (4) more frequent minimum-wage adjustment once at least every two years.

This new phase of minimum wage reform in 2004 made the process of minimum wage adjustment more formal and more regular. In the first part of the process, a provincial government drafts a proposal and submits it to the Ministry of Labor. The proposal is then discussed by local labor unions, as well as by trade and business communities. At the second stage, the Ministry of Labor reviews these proposals and provides suggestive revisions and other comments. If there are no more revision requests within 28 days, the provincial government is authorized to adjust minimum wages and publish it in local newspapers in 7 days. By the end of 2007, all provinces in China had successfully established the new minimum wage regime and also implemented enhanced enforcement measures. When the global financial crisis hit China in 2008, the Ministry of Human Resources and Social Security provided policy guidelines which allowed for a delay in minimum wage adjustment. Meanwhile, the new Labor Contract Law enacted in 2008 legislatively established the importance of minimum wage policies and minimum wages became one of the key components of China's labor market regulations. Figure 1 depicts the evolution of China's minimum wage policies over time.

Figure I: Minimum Wage Policy Timeline



3 Data

Our empirical estimation focuses on the effect of minimum wages on firm employment. We match a data set of China's manufacturing firms with local minimum wages at the county level, as well as other regional data on economic conditions. A detailed description of how we construct our sample can be found in the Online Appendix. Here, we briefly introduce our data sources and the criteria of sample construction.

3.1 Minimum Wages

Our minimum wage data are collected by the Ministry of Human Resources and Social Security from official reports of local governments. The data span ranges from 1992 to 2012, covering the period of our sample of manufacturing firms. This data set contains detailed information on all the adjustments of minimum wages at the county level[6]. To match minimum wages

[6]Minimum wages are specified in the forms of monthly wages, part-time hourly wages, and full-time hourly wages. We choose to use monthly minimum wages in our estimation rather than the other two due to the relevance of monthly wages to the manufacturing sector. Hiring in the manufacturing sector usually involves relatively long and stable employment contracts compared with the service sector. The other reason is that most counties merely set full-time hourly minimum wages based on monthly minimum wages divided by a factor of

with the annual data of firms, we calculate the total minimum wage effectively for every year, since we know specific dates on the implementation of minimum wage changes. These monthly aggregated minimum wages are referred to as annual minimum wages in this paper[7].

A primary advantage of this study is to make use of the information of minimum wages at the county level. A China's county (*xian*) is a division administered by a prefectural city (*shi*), which is in turn administered by a province (*sheng*)[8]. Counties, prefectural cities, and provinces represent the top three levels of China's administrative divisions. Using disaggregated data not only enlarges the variation of minimum wages in the estimation, but it also improves identification by allowing county-wise comparisons.

To our knowledge, this is one of the first papers to study this data set. Other than minimum wages, empirical research on China's policies rarely finds a target for which a complete panel at the county level can be acquired. The geographic division based on China's counties reduce the size of a geographic unit by a factor of about ten compared with the division based on municipal cities[9].

3.2 Firm Data

Our firm data are mainly from the Annual Survey of Industrial Firms (ASIF), also known as Chinese Industrial Enterprise Database (CIED). According to this survey, "large-scale" industrial firms file detailed reports every year to their local Bureaus of Statistics. The National Bureau of Statistics (NBS) then aggregates the data to produce key statistics for industrial output, such as those in the China Statistical Yearbook. Our sample spans from 1998 to 2007 and contains exactly the same number of observations used by NBS during all these years[10].

The ASIF data contains each firm's end-of-year balance sheet as well as the information on input and output. The data also show a firm's average number of employees over a year and its

around 175, presumably the typical number of working hours in a month for the manufacturing sector. The hourly minimum wage for full-time workers is thus practically the same measures as the monthly minimum wage.

[7] They can be considered a better indicator for annual wage cost than end-of-year minimum wages. Otherwise, firm variables at the annual level may not be ideally matched with the duration of minimum wages. For example, an enactment of a new minimum wage in July should be discounted half for the first year. Since we have information on the date of adjustment, we have the advantage of being able to construct the annual minimum wage. The annual minimum wage is thus preferable to other measures.

[8] As of 2007, there were 2,867 counties, 333 cities, and 31 provinces in mainland China. (See http://www.stats.gov.cn/tjsj/tjbz/xzqhdm/200802/t20080215_38311.html.) In China's system, a prefectural city is not equivalent to a prefectural administrative division. With this name abuse in mind, we refer all China's prefectural administrative divisions to prefectural cities. Furthermore, we refer them to cities if without confusion.

[9] County area varies in China. For counties where more than a few manufacturing firms are located, a typical county has an area from 20 to 2000 square kilometers. For reference, the area of Hong Kong is 1,104 square kilometers. Therefore, adjacent counties are more ideal comparison groups than adjacent cities if we want to control for time-varying unobservables. The data shows that 22 percent cities have uniform levels of minimum wages for their counties and sub-districts, like Beijing, however, the other 78 percent cities have within-variation in minimum wages. Figure IV shows the spatial distribution of cities according to variations of their county minimum wages. Minimum wages are invariant within a city if the city's minimum wages are same among its counties, and vice versa. We find that those cities with uniform minimum wages are concentrated in some provinces, especially two unpopulated western provinces, Tibet and Qianhai, and two northeastern provinces, Heilongjiang and Jilin.

[10] In general, compared with the first economic census in 2004, the 2004 survey includes 20 percent of industrial firms, but covers 91 percent of China's industrial output and 71 percent of China's industrial employment. As reported by the 2004 economic census, the total employment of China's manufacturing sector amounts to 93.4 million. The 2008 survey is not in our sample. For reference, compared with the second economic census in 2008, the 2008 survey includes 22 percent of industrial firms, but covers 88 percent of China's industrial sales and 72 percent of industrial employment.

annual wage bills. Although we cannot identify the number of firm employees being paid below the level of minimum wages, we are able to calculate each firm's average wage per employee, which can arguably be used as an indicator of a firm's exposure to minimum wage shocks.

The 2004 economic census is merged into the ASIF data since the ASIF data undersamples small firms in 2004 relative to other years[11]. After the construction of a panel sample for all the firms in the manufacturing sector, we have in total 2,043,435 observations in the unbalanced panel for ten years. The attrition rate in our sample varies from 8.2 percent to 20.3 percent over the nine years of 1999-2007. Since the rate of re-entry[12] is around 10 percent over time, it is likely that a significant amount of firms left the sample not because they closed business but because of sampling omissions.

The main reason of choosing the manufacturing sector, instead of the service sector[13], for the study of minimum wages is that this sector is of great significance in China's labor market. Due to local government policies, the service sector has usually discriminated against migrant workers more than the manufacturing sector. Second, the overall wage rate of China's manufacturing sector is relatively low. Our sample shows that the wage rate of China's manufacturing sector were always below city average wages over the sample period[14], as Ge and Yang (2014) also shows that the average real wage of the manufacturing sector is 2 percent below that of the whole sample in 2007 with the countywide data from the Urban Household Survey. Finally, the choice for the manufacturing sector is also consistent with the vast literature studying the ASIF data, so our results can be easily compared.

3.3 Macroeconomic Factors

Economic variables at the city and provincial level[15] are collected to control for the determinants of minimum wage policies and the market factors affecting firm employment. The major source of city variables is the China Statistical Yearbook Database from CNKI[16]. Our city database contains a panel of 337 cities[17] over the period of 1990-2012, with interpolation for some missing values in early years. This annual data set thereby can completely match up with the sample

[11] In this paper, firm ownership is categorized as state, collective, private, or foreign if it is explicitly defined in the dataset, otherwise it is attributed to the stockholder using the share of paid-in capital. We also follow the standard definition of a foreign firm in China which only requires more than 25 percent of stock shares to be controlled by foreigners. In principle, firms in the survey before 2007 should include all the firms in the sectors of mining, manufacturing, and utility, with annual sales more than five million Yuan. We refer to firms with annual sales above five million Yuan as "large firms", and other firms as "small firms". As a consequence, the sampling of the ASIF data is by design biased towards large firms. In regard to small firms, the reality is that the data still contains some small, non-state firms, and for small firms, the sampling bias is towards state firms. For more details, please see Appendix.

[12] The rate of re-entry is calculated by the ratio of re-entrants to total entrants for every year.

[13] For example, restaurants are chosen as the primary industry in main studies for western countries.

[14] The wage rate of China's manufacturing sector is calculated by the median of firm average wages over the county. City average wages are denoted by the median of city average wages over the county. The ratio between them was 65 percent in 2004 and remained stable over the period of 2001-2007. We can also examine the gap between them at the city level. In 2004, the wages of manufacturing firms were below city average wages in 96 percent of cities.

[15] Other than minimum wages, we don't have a complete panel data of economic variables at the county level. Some variables, such as consumer price index, can only be observed at the province level.

[16] China National Knowledge Infrastructure, www.cnki.net

[17] These 337 cities include four directly controlled municipalities by the central government as well as those 333 prefectural cities. Directly controlled municipalities are administered at the highest level, are are much larger in terms of their economic size, but their area size is similar to that of prefectural cities.

of manufacturing firms[18].

3.4 Geography and Neighbor Counties

Our analysis utilizes a data set of neighbor county-pairs in the year of 2007. Two counties are defined as neighbors if (1) they share same border either on land, in rivers, or in coastal waters, and (2) the distance between their centroids is no more than eighty kilometers. The median number of county neighbors is six in the data. Neighbor counties can still differ on many economic conditions, but because of geographic adjacency, we are more inclined to assume neighbor counties may experience similar growth factors, especially unobservable shocks.

4 Theoretical Background

By laying the micro-foundations of firm behavior, basic theory can guide us to select relevant explanatory variables and provide sign predictions of their effects in the regression. On the one hand, if labor supply is perfectly elastic, the response of firm employment to minimum wages depends on the shape of each firm's labor demand schedule in the range of the minimum and, moreover, market prices such as the average wage and the cost of capital investment, due to a firm's ability to substitute one input for another. On the other hand, if labor supply is imperfectly elastic, a firm needs to react to changes on the supply side[19].

We first assume labor supply is perfectly elastic and thus marginal cost of labor is equal to the market wage. In this case, a firm's hiring depends on its productivity and product demand. The cost channel suggests that an increase in the market wage must reduce a firm's employment. The second theory allows labor supply not to be perfectly elastic, so the implementation of wage minima may reduce a firm's marginal cost although total cost of labor rises. As a result, a increase in the market wage raises firm labor demand and expands firm hiring. These two theories correspond to the competitive model and the monopsony model in the literature of minimum wages (Brown, 1999; Neumark and Wascher, 2008; Schmitt, 2013).

4.1 Labor Demand

If factor markets are competitive, a firm's employment decisions depend on factor prices and how it supplies its product market. It is then straightforward to assume the product market is monopolistically competitive, so a firm determines its own product price and supply.

A formal model is presented in Appendix. Assume a firm has a production function given by

$$Y = AK^{\alpha}L^{\beta}M^{1-\alpha-\beta},$$

[18] Occasionally cities and counties were divided up and/or combined into other regions. This division restructuring occurred more frequently in the 1990s and much less after 2003. We collect the corresponding information, and adjust the city and county code for all the affected firms. Because adjustments to minimum wages should take into account all the regional conditions, no county should have experienced a hike in minimum wages due to the change of its administrative division. This fact is confirmed in the data.

[19] Previous studies on regional employment typically interpret the employment equation as demand equations, although many include as explanatory variables supply-side variables because regional employment is determined by the interaction of demand-side factors and supply-side factors (Card and Krueger, 1995, 185).

where Y, K, M, and L denotes output, capital input, intermediate input, and labor input respectively. A can be any firm characteristic that determines firm size and is in general viewed as firm-specific productivity. In competitive factor markets, α, β, and $1-\alpha-\beta$ can be explained as the cost share of each factor for a firm, or explained as the elasticities of marginal cost to each factor price. Labor demand is given by

$$L = \bar{Y}\left[\frac{1}{A}\left(\frac{w/\bar{P}}{\beta}\right)^{\beta}\left(\frac{r/\bar{P}}{\alpha}\right)^{\alpha}\left(\frac{p_M/\bar{P}}{1-\alpha-\beta}\right)^{1-\alpha-\beta}\right]^{1-\sigma}\frac{\beta}{w/\bar{P}}\left(\frac{\sigma}{\sigma-1}\right)^{-\sigma} \tag{1}$$

This equation shows that fundamental determinants of firm employment are firm characteristics A, price elasticity σ, and market conditions $\bar{Y}$, $w/\bar{P}$, $r/\bar{P}$, and $p_M/\bar{P}$.[20] A competitive labor market implies that minimum wages are negatively correlated with firm employment. The elasticity of labor demand to the wage rate is $-(1+\beta(\sigma-1))$[21].

Equation (1) leads to a linear regression model to estimate the wage elasticity of firm employment. Furthermore, we are restricted to include only market prices and aggregate demand in the empirical estimation. Other market factors that determine the market wage in equilibrium, for example, labor flow and growth, are not necessary to be included in our estimations, whereas these market factors cause a serious endogeneity problem in the regressions on regional employment.

Firm employment can also be related to other specifications in the sense that marginal cost of labor may be increasing. For example, other than productivity, labor adjustment frictions are important factors for firm employment even on an annual basis. In the empirical analysis, we control for lagged firm employment to address this issue. This theoretical framework underpins our variable choice in the estimation.

4.2 Labor Supply

The more complicated problem is to consider imperfectly elastic labor supply. Stigler (1946) describes a labor market with imperfect competition in which a monopsony may increase employment due to an increase in the minimum wage. Card and Krueger (1995) provide a search model in which the elasticity of labor supply can be reasonably large, which helps to justify the positive or negligible correlations between minimum wages and employment suggested by the "New Minimum Wage Research" based on regional panel data or firm surveys. Our Appendix applies a model with a non-discriminating monopsonist to illustrate the intuition. For a monopsonist, firm employment is likely to be supply-constrained. In response to a minimum wage hike, the optimal decision is to increase hiring along the supply curve, rather than labor demand.

The ASIF data does not give us ideal indicators to measure the shape of labor supply. Given

[20] The importance to control for variables measuring output prices and the cost of capital is stressed in Card and Krueger (1995, 184).

[21] Intuitively, the first term "1" in the sum indicates the structure of constant cost share of labor. The second term $\beta(\sigma-1)$ shows that the effect of wage on a firm's average cost depends on labor share β and price elasticity σ. Finally, the part of $\beta\left(\frac{\sigma}{\sigma-1}\right)^{-\sigma}$ in the employment equation implies that firm employment is correlated positively with firm labor share and price elasticity.

a firm's labor demand, its average wage is a straightforward indicator of the elasticity of labor supply if its employment is determined mainly by the supply side. This motivates us to use the lagged firm wage to separate firms and examine the heterogeneous effect of minimum wages on different firm groups in the empirical analysis. We also need to control for market supply conditions, such as labor force growth.

5 Identification and Empirical Framework

5.1 Minimum Wage Determination

Minimum wages, as indicators of policy outcome, are not exogenous in the empirical analysis. We need to control for economic determinants of the minimum wage to address this issue because firms have the same ability to observe these variables and every decision is influenced by these macroeconomic conditions. The advantage of using firm employment over regional employment is that it is much easier and precise to account for a firm's employment demand with the aid of firm data. Market prices, also including market factors relevant to regional labor demand and labor supply are also controlled for. The second effort we take to improve the quality of identification is to use dynamic panel estimation because past firm employment possesses most information on a firm's employment specificity. By including lagged dependent variable as one explanatory variable, the estimated elasticity can be interpreted as the impact on employment growth, which is emphasized by recent studies (Meer and West, 2013). Third, we examine the variation within neighbor county-pairs. This strategy for using the information of geographic proximity has been used in the analysis of minimum wages since Card and Krueger (1994), previously on a small scale.

The Adjustment of Local Minimum Wages

The adjustment of local minimum wages is a regular policy decision led by the provincial and central government, and it also involves considerations and negotiations of the city and county government. For the identification of minimum wage shocks, it is necessary to investigate quantitatively the process of this adjustment. This helps us control for government concerns that could lead to both changes in minimum wages and local economies. As documented literally in the law, minimum wage adjustment should take into account the following policy variables:

$$MW = f(C, S, A, U, E, a),$$

where C is the average level of consumption, S is social security, A is the local average wage, U is the unemployment rate, E is the general condition of local economy, and a refers to other factors.

In practice, when choosing a new minimum wage, government officials face a trade-off. On the one hand, the government has an incentive to freeze or slow down the adjustment in the minimum wage in order to avert labor cost hikes and promote private investment, which otherwise will ultimately lead to employment reductions. On the other hand, the concern

about social stability and citizen welfare motivates the government to improve labor market regulations. This implies that we have both welfare and growth imperatives that must be accounted for in the setting of local minimum wages. Figure II shows the trend of mean annual minimum wages and mean employee wages at the level of prefectual cities. The ratio of these two wage levels clearly has been stable in most of the cities.

Local government does not have a precise coded to calculate the adjustment needed for the next period. We attempt to capture these welfare and growth considerations with variables in four categories and estimate the relationship in a linear model.

The first is local labor income, which should be closely related to living costs in a city and thus serves as an indicator of welfare concerns. We use city average wages per employee to measure the level of city wages. A rise in the consumer price leads to a deterioration of worker welfare. We adopt provincial CPI as the deflator. Consumer prices attract the attention of government officials and this price index is directly related to the standard living of low-income workers. We choose the CPI as the price deflator for all the nominal wages[22].

The second category relates to the prospects for economic growth in the local area. We choose the lagged growth rate of GDP per capita and fixed asset investment to represent this expectation. Past prosperity is likely to influence the expectations of the trajectory of income; the inclusion of the lagged growth rate captures this effect. Fixed-asset investment is often used by local government as one of the main propellers to boost the economy, and the effect can last for at least one year after an investment boom. If growth concerns dominate, these two variables should show a positive relationship with minimum wage adjustment.

The third category includes industrial policies that balances economic growth. We include output shares of the secondary and the tertiary industries to address how government weighs the importance of the manufacturing sector. The growth rate of foreign direct investment is also used to see whether government officials are concerned with the negative impact of minimum wage hikes on potential investors from abroad.

The fourth factor that we control for is the condition of local labor markets. We use the lagged growth rate of the labor force and the unemployment rate for this. High growth rates of urban labor in China usually are a consequence of labor migration from rural areas. If a region has attracted many migrants and formed mature migrant network, according to the growth concern, local officials should not worry too much about constraints on future labor supply. For welfare considerations, high growth of the labor force may widen the income gap in a city thus motivating the government to increase the minimum wage. This leads to an ambiguous prediction about the coefficient sign of labor force growth. The unemployment rate is an important welfare indicator but we must note that it is measured in China with significant flaws. Based on welfare considerations, we expect to see negative impact of unemployment on the policy decision of raising minimum wages.

[22]We use urban consumer price index to account for concerns of government officials. Furthermore, a majority of manufacturing firms are located in the urban area. CPI measures relative changes in living cost over time. Since only relative variations matter, CPI is suffice to be used.

The Determinants of Local Minimum Wages

We run a regression on city minimum wages with fixed effects to show the relevance of these factors. In the main estimations on the employment elasticity of the minimum wage, all of the determinants will then be included as explanatory variables. The estimation equation is standard as follows:

$$\ln MW_{ct} = \alpha + X_{i,t-1}\beta + \mu_c + \tau_t + \varepsilon_{ct},$$

where MW_{ct} denotes the minimum wage in city c at year t. μ_c is city c's fixed effect and τ_t represents year fixed effects. ε_{ct} is the error term.

If the variation of minimum wages after controlling for these determinants cannot be explained by a firm's own observation, we will expect its hiring decision is not affected further by some missing factors and the issue of endogeneity could be alleviated. This analysis also helps us understand cross-sectional variations of the relative minimum wage, denoted by the ratio of the minimum wage to the average wage, as the lagged average wage serves as one explanatory variable.

Table III present summary statistics for minimum wages and city variables over 1994-2011. We find that the median of minimum wages were around one third of the median of city wages per employee. Furthermore, the median of city wages per employee was one quarter higher than the median of city GDP per capita. The growth of GDP per capita and FDI was at high levels and peaked in the run-up of the global financial crisis in 2008. The share of tertiary industry was rather stable, while the share of secondary industry had been rising since 2001.

We begin by examining the determinants of minimum wage adjustment at the city level. The minimum wage data covers 2,374 county-level districts in all the cities. Therefore, we choose to study the determinants of minimum wages at the city level. In regressions at the firm level, county minimum wages are used to increase the variation of this key variable.

Table IV shows how minimum wages adjust to policy variables[23]. We limit our use of economic indicators to the city level. In the basic estimation with fixed effects, 346 cities are included. The sample period is from 1994 to 2011[24].

The dependent variable is the logarithm of the city minimum wage, calculated by the average of the county minimum wages. Column 1 to column 3 use the sample from 2004 to 2011, the period after the enforcement reform, while column 4 to column 6 contains results for the period of from 1994 to 2003 before enforcement tightening. Minimum wages and city wages are deflated by CPI.

One notable finding from the results for the period before enforcement tightening is that none of the coefficients are statistically significant despite high within R^2. This explains low frequency of adjustment in minimum wages before 2004. By contrast, the coefficient of city wages, growth of GDP, are fixed asset investment are statistically significant at the level of 1% after 2004.

The explanatory variables are grouped into three sets, and are all lagged by one year. The

[23]The minimum wage in the following refers to the annual minimum wage we defined in the above.

[24]The law was enacted in 1994, but because some cities started to report minimum wages several years later, the city sample is unbalanced.

first set measures living costs in a city, which includes city average wages in log terms. Column 1 shows that after 2004, living cost are strongly positively related to minimum wages with an elasticity of 2.96. Column 2 shows that fixed-asset investment has positive effects on minimum wages, whereas the growth rate of city GDP per capita has negative effects. The positive coefficient on fixed-asset investment is consistent with the view that this variable proxies for city growth prospects. The negative effect of GDP growth is difficult to explain. One possible reason is that local government is keen to maintain growth rates, so fast growth in the past put pressure on the incentive to raise minimum wages. The positive coefficients of the size of the secondary and the tertiary industry may indicate the welfare concerns of government officials, but they are both statistically insignificant. Column 3 also includes conditions of local labor markets. Both the coefficients of the growth rate of the labor force and the unemployment rate are not statistically significant.

By and large, the comparison of within- and between-R^2 shows that within-city variation of minimum wages is explained significantly well, but cross-city variation is not. On the one hand, local policy variables are highly correlated with minimum wages throughout the time. On the other hand, this evidence suggests that although the countrywide minimum-wage law stipulates guidance for the adjustment of minimum wages, local government has substantial leeway to accommodate the adjustment to local conditions. Because we exclude the few firms that changed location in our sample and if we ignore a firm's incentive to change locations, only within variation of minimum wages is relevant in the estimation. By controlling for these main variables at the city level such as city average wages and CPI, we find that most other variables do not add explanatory power to the regression. Unexplained changes in minimum wages therefore can be viewed as exogenous variations for individual firms. Our regressions below with the minimum wage as an explanatory variable also include these lagged city variables, for which the coefficients are suppressed in reporting tables.

5.2 Neighbor County Pairs

The strategy of using neighbor county-pairs is analogous to regression discontinuity design. The idea is to use neighboring areas to control for unobservable factors that change over time. County area varies in China. For counties where more than a few manufacturing firms are located, a typical county has an area from 20 to 2000 square kilometers[25]. Therefore, commute or migration across county borders incurs low cost for workers. As argued in Dube et al. (2010), contiguous regions are more likely to have similar employment trends.

Figure III shows the spatial distribution of identified neighbor county pairs. The treatment threshold is selected as thirty percent. We find that a large part of pairs are counties crossing provincial borders. Nonetheless, we can see that significant difference in minimum wage hikes still happened in provinces such as Liaoning, Hunan, Jiangxi, and Guangdong.

One county may exist in different county pairs. It is unnecessary and sometimes impossible to combine such county pairs. Repeated counties will be assigned with lower weights in estimations and standard errors are adjusted correspondingly.

[25] For reference, the area of Hong Kong is 1,104 square kilometers.

5.3 Empirical Model

Based on our panel sample, we apply a dynamic model with unobserved, time-invariant effects at the firm level. One of the main dependent variables is the logarithm of a firm's employment in a year[26]. Following Arellano and Bond (1991), one-period lagged dependent variables are included as explanatory variables. This creates a dynamic bias that needs to be addressed. Hence, we estimate a first-difference model with GMM-style instruments as in the Arellano-Bond model (Difference GMM). Instruments are limited to one lag.

In our theoretical framework, Equation (1) leads to a linear function for $\ln L_{it}$:

$$\ln L_{it} = f\left(\ln L_{i,t-1}, \ln A_{it}, \ln\left(\frac{W_{it}}{P_{it}}\right), \ln\left(\frac{P_{k,it}}{P_{it}}\right), \ln\left(\frac{P_{m,it}}{P_{it}}\right), \ldots\right)$$

Therefore, the corresponding estimation equation is

$$\ln L_{it} = \alpha + \beta_1 \ln L_{i,t-1} + X_{it}\beta + X_{ct}\beta + \gamma \ln MW_{ct} + \mu_i + \tau_t + \varepsilon_{it}, \tag{2}$$

where i and t denote firm and year respectively. L_{it} is the dependent variable, firm employment. X_{it} then controls for firm i's characteristics at year t, together with regional and industry conditions for firm i denoted by X_{ct}. MW_{ct} is the annual minimum wage in county c at year t. μ_i is firm i's fixed effect and τ_t represents year fixed effects. ε_{it} is the error term, which we assume satisfies the exogeneity condition. γ measures the elasticity of minimum wages on firm employment, and it is the key parameter we estimate.

Our alternative identification strategy matches counties with their neighbor counties. By examining within county-pair variation, we control for all the trends experienced by both counties. After having specified all the neighbor county pairs, we merge those pairs with their local firms[27]. As an extension of equation (2), we pool these firms together and estimate the following equations:

$$\ln L_{it} = \alpha + \beta_1 \ln L_{i,t-1} + X_{it}\beta + X_{ct}\beta + \gamma \ln MW_{ct} + \mu_i + \mu_p \times \tau_t + \varepsilon_{it}, \tag{3}$$

μ_p denotes the fixed effect of county pairs p. $\mu_p = 1$ if firm i is located in one of the counties in the county pair p. Interacted with year dummy variables, μ_p does not cancel out after first differencing. Intuitively, all the county pairs are stacked up together and γ measures the average of treatment effects for these pairs. When there is only one neighbor-pair in the sample, it reduces to the typical analysis of difference-in-difference for policy evaluation.

Variables Related to Firm Employment

The main dependent variable is firm employment. Explanatory variables are selected as proxies for the variables in our theoretical framework.

Firm employment: L_i. It is reported as the average of a firm's end-of-month number of

[26] Logarithms of most of the explanatory variables, if they are not ratios, for instance, are also used, so their coefficients should be interpreted as elasticities.

[27] We dropped firms that changed locations over the sample period.

employees in a year. We also use the variable of end-of-year employees to diagnose and replace suspected erroneous data on average employees.

Firm wage: W_i. We compute a firm's total wage bill as the sum of its reported wages, monetary allowances, and unemployment insurance. A firm's wage is equal to the ratio of its total wages to its employment. Because this variable explicitly involves firm employment, and also because it is jointly determined with firm employment, we do not use firm wages as an explanatory variable in general.

Labor cost: w. We do not observe the market price of labor input faced by each firm. The price of labor input in this paper is measured jointly by county minimum wages (MW), city average wages, and industry average wages imputed from the firm sample. We use the log of minimum wages as the key regressor, while controlling for the log of city average wages separately. Some of the studies on minimum wages use the ratio of the minimum wages to the average wage as the main explanatory variable, multiplied by the fraction of industry employment covered by the minimum wage. At the aggregate level, the so-called Kaitz index is the coverage-weighted minimum wage relative to the average wage. In our case, on the one hand, most of the firms in China's manufacturing sector are covered by the policy. On the other hand, coverage is not important for an individual firm because labor flow between covered and uncovered labor markets is not relevant to a firm's decision on labor hiring[28].

Other factor prices: r and p_M. Although it is theoretically important to control for all factor prices, we do not have goods measures at a detailed level. We choose the price index of fixed asset investment at the province level, and the price index of intermediate inputs at the industry level.

Aggregate demand: $\bar{Y}$. This includes industry output and city GDP per capita. Industry output is an indicator of industry aggregate demand measured by total output at the 4-digit industry level.

Price elasticity: σ. This is measured by the Herfindahl index (HHI) for each industry at the 4-digit level. σ is negatively correlated with HHI, so we expect a negative coefficient for HHI.

Labor income share. This is measured by the share of industry labor income in the value of industry gross output. Because only variation across industry matters for our estimation, if the labor share[29] in the data is biased downward but the bias does not correlate with industry distribution, we don't need to adjust this measure. We expect a positive coefficient for labor share.

Productivity: A_i. We use the profit margin as one proxy for firm productivity. In addition, ownership is widely regonized to be a relatively exogenous indicator of firm productivity. In our sample, firm owners are categorized as state, collective, private, or foreign if they are explicitly stated in the data, otherwise it is attributed to the stakeholder using the share of paid-in capital. Foreign investors are further divided as from the region of HMT (Hong Kong SAR, Macao, and Taiwan), or from other countries. The export-to-sales ratio is also included given the positive

[28] For detailed discussion that the minimum wage in the US arguably is a more appropriate variable than is the Kaitz index, see Card and Krueger (1995, 215). One particular reason is that the minimum wage and the average wage are not independent sources of variation.

[29] Under-reporting of labor share in the ASIF data has been well documented. For example, see Hsieh and Klenow (2009)

relationship between firm exporting choice and productivity indicated by trade theory.

Lagged firm employment: $L_{i,t-1}$. Adjustment costs can be captured by using the lagged dependent variable as one regressor. For this dynamic model, we need to use $L_{i,t-2}$ as the instrument for $L_{i,t-1}$.

Firm size: $S_{i,t-1}$. Aside from $L_{i,t-1}$, lagged annual real sales are used to account for firm size. A firm's sales and employment are highly correlated. We expect the variable of firm sales to capture more information about a firm's production scale.

6 Main Results

This section presents our main results of the minimum wage effect on firm employment. Our analysis proceeds in three steps. We first estimate the average effects of minimum wage on firm employment, as well as on firm wages over the period of 2000-2007. Then we estimate the heterogeneous effects of minimum wages according to firm characteristics, in particular, firm wages.

6.1 Impact of Minimum Wages at the Firm Level

This section estimate the elasticity of the minimum wage with equation (2) and (3). The summary statistics of firm variables are shown in table III. Figure (V) shows that there are a significant amount of firms paying average employee wages lower than minimum wages indicated by the variable of firms below minimum wage. This does not necessarily mean non-compliance for these firms. We think that the data of firm wage bills in the ASIF data may have larger measurement errors than other main variables because they are more easily to be confused with the corresponding accounting subject with similar names. Other than this, one well-known issue of the ASIF data is that reported payments to labor omit substantial fringe benefits and employer Social Security contributions (Hsieh and Klenow, 2009). Therefore, employee wages are systematically under-reported if they are compared with other wage measures, and the statistics of non-compliance based on firm employee wages should be explained with caution[30].

The Average Elasticity and Enforcement Tightening

As we have discussed, we focus on variation within neighbor-pairs. This allows us to control for similar trends in the neighborhood area. Our sample allows us to estimate the elasticity of the minimum wage for the period of 2000-2007. The tightening of minimum wage enforcement may increase the effect of minimum wages on firm wages and firm employment, but previous literature indicates ambiguous results (Draca et al., 2011; Freeman, 2010). This section investigates the effect of minimum wages by different periods. We study the change of minimum wage effects over time and see if the change is relevant to changes in minimum wage regulations.

Table V shows the effects of minimum wages on firm employment over different periods. The whole set of explanatory variables including firm characteristics and macroeconomic conditions

[30]For example, if 3 percent of firms have average wages lower than the minimum wage, there are very likely to be a considerable amount, say more than 10 percent, of firms who pay some employees at a rate below the minimum wage. This is not supported by current evidence.

is included, whose coefficients are reported in Table VI and will be discussed below. When the whole sample is used, we interact minimum wage with year dummy variables and include it in the regression with a full set of firm and city variables. We also use subsamples specific to certain periods. The result in the last column 7 provides elasticities by each year using the whole sample and suggests the change of minimum wage impacts did not coincide with the enforcement reform entirely. The estimation shows that minimum wages during the period of 2000-2002 had insignificantly negative effects, but the effect turned to be more negative in 2003, rather than in 2004, although the change is not significant. The year 2004, on the contrary, did not see an enlargement in the negative effect of minimum wages. After 2005, the effect of minimum wages became highly significant and more negative. This result roughly shows a lagged effect of enforcement tightening. The reform was enacted on March 1, 2004, so the response of individual agents, such as firms and workers, could be delayed. To verify this argument, column 5 divides the whole period into two episodes: pre-tightening, from 2000 to 2003, and post-tightening, from 2004 to 2007. Interacting minimum wages with the dummy of these two episodes, we find that the negative effect of minimum wages on firm employment after the tightening is slightly larger, but does not differ significantly. Column 6 estimate the effect of minimum wages separately by the period of 2000-2004 and 2005-2007, showing that the difference between the effects in these two periods is clearly noticeable. The elasticity for 2000-2004 is -0.027, not statistically significant; the elasticity for 2005-2007 is -0.067, statistically significant at the 1% level. The difference between these two elasticities is also statistically significant. This motivates us to follow this division of the sample period in main regressions. Column 1 and 2 uses the subsample of 2000-2004 and 2005-2007 to estimate the elasticity over time. The estimate -0.103 for 2005-2007 is more negative than using the whole sample. An elasticity of -0.103 means that for a minimum wage hike of ten percent, firms tend to reduce hiring by 1.03 percent. With the consideration that our sample includes almost most of the large manufacturing firms, the effect of minimum wages is of practical importance. By contrast, the elasticity estimated using the subsample of 2000-2004 is 0.022, insignificantly from zero. In the following, we focus on the period division as 2000-2004 and 2005-2007. Column 3 and column 4 also shows the elasticities of minimum wages using the subsamples divided by 2000-2003 and 2004-2007. The elasticities become closer to zero, but still differ significantly.

To disentangle the effects of the minimum wage from other macroeconomic variables, we estimate the model using different sets of variables which are external to a firm. Table VI shows the results estimated from equation (3) when we divide the sample period as the period of 2000-2004 and the period of 2005-2007. The coefficients in column 3 correspond to the specification used to estimate the elasticity of the minimum wage in column 1 of Table V. Similarly, the coefficients in column 6 are estimated together with the elasticity of the minimum wage reported in column 2 of Table V. We see that the introduction of other regional variables does not dilute the effect of minimum wages. The coefficients of the minimum wage vary from -0.059 to -0.103 as from column 1 to column 3 when we introduce more regional variables for the period of 2005-2007. All of the elasticities are statistically significant from zero. This shows that the result for minimum wages is robust to the use of external controls. The effects of the

minimum wage in 2000-2004, however, are always statistically insignificant in column 4 to 6 for different sets of macroeconomic variables.

The coefficients of firm variables are consistent with theoretical predictions. We find that employment adjustment is slow at the firm level and lagged employment has strong explanatory power. Firm size indicated by annual sales shows negative relationship with employment, but the coefficient is even smaller in value than that of minimum wages. Foreign firms are used as the reference group for ownership categories. The result shows that state firms are similar to foreign firms in terms of their employment levels after the tightening, but they hire significantly more before 2005. Compared with foreign firms, private firms generally hire fewer workers for the whole period of 2000-2007, while firms with HMT (Hong Kong SAR, Macau, and Taiwan POC) investors only hire more after 2005. Firms with high profitability tend to hire more workers. However, firms with more exports may hire fewer, which shows the variable of exports is not a good proxy for labor demand. The negative coefficient of HHI and the positive coefficient of industry labor share are in line with theory predictions. The coefficient of city wages, though negative in column 3, is statistically insignificant from zero. We also control for lagged city wages, so the coefficient of current-year city wages does not measure their overall effect. The coefficient of city GDP per capita is negative, not consistent with the model prediction. On the one hand, we attempt to use it to control for local demand. On the other hand, city GDP may capture some factors of cost.

We compare the results whether or not to use dummy variables for neighbor county pairs in Table VII. Column 1 and column 2 show both results respectively. Minimum wages (MW) are measured in the continuous term. We find that in the model with pair dummy variables, the coefficient of minimum wages exhibit a negative sign, with the value of -0.103, significant from zero at the 1% level. By contrast, the coefficient of minimum wages without pair dummy variables is -0.031, significant from zero at the 5% level. This implies whether or not to control for unobservable factors using a neighbor county influence the result and shows the advantage of our data and approach. The determinants of the minimum wage that we cannot observe are likely to be positively correlated with firm employment. For example, good news of regional growth motivates firms to expand capacity while local governments have confidence in raising minimum wages without having to worry about the negative impact of the policy. If these two effects are positively correlated, missing such factors will cause an upward bias. If the approach of using neighbor counties to control for more unobservable factors is effective, estimated elasticities should be more negative than those without using the controls of neighbor county-pairs. Our results are consistent with this argument.

The Effect of Minimum Wages on Firm Employee Wages

Although minimum wage hikes can in theory impact firm employment in positive or negative ways, it always works through the channel of raising employee wages. Basic theory also predicts that minimum wage hikes lead to higher average wages in a firm unambiguously. To verify this channel, we use a similar model to equation (3) and estimate the effect of minimum wages on firm employee wages. Table VIII provides these estimates. The structure of explanatory

variables is same as in the employment regressions except for the replacement of the lagged dependent variable and the corresponding instrument. The dependent variable W_t is the log number of a firm's per employee wage. Column 1 shows the effect for the period of 2005-2007. The elasticity of minimum wages is considerably large with the value of 0.349. This implies that minimum hikes explain one third of firm wage increase. The elasticity of city average wage is even larger and equal to 0.491. By contrast, the elasticities of industry wages is 0.132. We also find that large firms (with high sales) and private firms tend to pay lower wages. Firms with higher profitability by their profit margins offer higher wage rates. As the feature of our reduced-form analysis, estimated elasticities measure comparative statics between equilibria. In reality, an increase in the minimum wage directly raises a firm's wage payment to low-wage workers, and may also indirectly change the situation for high-income workers in the labor market. The evidence shows that minimum wages have large effects on the market price rate of labor, and thus lends support to the channel through which minimum wages can affect firm employment by raising labor cost.

As we estimate the effect of minimum wages on firm wages for the period of 2000-2004, we find in column 2 that the elasticity of the minimum wage is quite similar to that in the post-tightening period. One distinction is the effect of industry wages, falling from 0.132 during 2005-2007 to 0.013 during 2000-2004.

The minimum wage has similar effect on firm wages before and after enforcement tightening, but shows distinct impact on firm employment during these two episodes. There are several explanations for this results. Fringe benefits, though being not observed completely from our data, hinge on the wage rate, the extent to which could vary over time, so the wage only measure a proportion of worker income from firms. The second possible factor is the ability of passing the cost increase on to the product. As the product becomes more competitive in later years, this ability can be weakened, which affects a firm's hiring decision.

6.2 Heterogeneous Effects

Grouping Based on Firm Wages

We divide firms into ten decile groups based on each firm's average wage relatively within the city. In a single regression we estimate the effect of minimum wages separately for these groups. Table IX shows the results. We control for the same set of other variables as above. Consistent with the theory based on the search model, the negative effect of minimum wages on firm employment is larger for low-wage firms compared with high-wage firms. Specifically, most of the firm hirings are related to a negative impact from minimum wage hikes. In column 1 for the period of 2005-2007, the firms in the top wage-decile have an employment elasticity of -0.048, statistically insignificant from zero. The group in the bottom decile by contrast have a negative elasticity of employment to minimum wages being -0.153, which is highly significant. In theory, for these low-wage firms, labor demand is binding and higher wage cost reduces their labor demand and thus reduces firm employment. However, for high-wage firms, higher wage cost in contrast raises their labor demand because they have excess demand relative to labor supply under previous wage rates. Column 2 for the period of 2000-2004 shows that the monotone

relationship between minimum wage elasticities and firm wage remains. Specifically, the firms in the top decile have an significant elasticity of 0.096, while the firms in the bottom wage decile have an elasticity of -0.034, which becomes statistically insignificant. This verifies our analysis of the wage channel for the minimum wage effect. The average effect the minimum wage on firm employment is small before enforcement tightening is because all the firms responded to minimum wage hikes less negatively, or more positively.

Full Set of Heterogeneous Characteristics

Table X investigates this heterogeneous effect of minimum wages further by adding interaction terms of minimum wages with firm variables. Column 1 for 2005-2007 uses one interaction variable: the product of minimum wages and firm wages. The positive effect verifies our findings in Table IX. When we add a full set of interaction terms, the heterogeneous effect based on firm wages rises slightly from 0.117 to 0.124. For other variables, we find that state firms tend to reduce employment much more than other firms in response to minimum wage hikes. At the same time, firms with lower profit margins tend to cut employment more than firms with higher profitability in response to minimum wage hikes. Firms who operate in a concentrated industry do not show a tendency to reduce their hirings in response to an increase in minimum wages. Interestingly, for the period of 2000-2004, the heterogeneous effect due to firm wage becomes less significant, though still positive. The heterogeneous effects due to other variables are quite similar in these two episodes.

7 Robustness Checks

7.1 Dummy Variable of Treatment

Table XI shows the result when we use the dummy variable of large minimum wage hikes instead of continuous measurement in column 2. By comparison, we see that both models deliver similar results. The coefficient for the treatment dummy is -0.006. As we know that the median of minimum wage hikes for treatment counties is 8 percent, the results in column 1 and column 2 are consistent[31]. The remaining difference shows the relationship between firm employment and minimum wages is not perfectly linear. We focus on the model with continuous measurement for minimum wages.

7.2 Sample Attrition

The rate of attrition of our sample is about 10 percent every year. We do not have a good estimate to attribute firm exit either to stopping business or merely leaving the sample, since the rate of re-entry is also high at 10 percent, calculated based on previous attritions. Whatever the reason of attrition, we can use Heckman's method (Heckit) to address this issue, although this needs a strong assumption of linearity for the unobservable fixed effect (See Wooldridge, 2010).

[31] $-0.103 \times 0.08 = -0.008$

The first stage of the probit model to explain firm attrition is important in its own right. The binary dependent variable is whether a firm will stay in the sample in the next period. The explanatory variables are firm characteristics, including sales, employment, ownership, profit margins, firm age, and squared firm age in every year. The set of these explanatory variables are similar the regressions on firm employment except we add firm age and squared firm age to the model and these variables are included without lags. County minimum wages and city fixed effects are used as additional controls. A pooled probit model is estimated separately for each year, and the results are shown in Table XII. Generally, firms with larger sales, larger employment, and higher profit margins are more likely to stay in the sample. Because the data source of the year 2004 is from the economic census, the results for the year 2004 in column 5 are slightly different from other years: the coefficient of sales becomes much larger while other coefficients become insignificant. As for ownership, state firms are most likely to leave the sample and foreign firms are most likely to stay. We also find that younger firms are more likely to stay for the next period. Finally, the effect of county minimum wages is not statistically significant except the year of 2003.

The second stage adds to the previous model of equation (3) the interaction term of estimated inverse Mills ratios and year dummy variables. The estimation equation now is given by

$$\ln Y_{it} = \alpha + \beta_1 \ln Y_{i,t-1} + X_{it}\beta + \gamma \ln MW_{ct} + \mu_i + \mu_p \times \tau_t + \rho_t \left(\hat{\lambda}_{it} \times \tau_t\right) + \varepsilon_{it}, \qquad (4)$$

where $\hat{\lambda}_{it} \times \tau_t$ is an interaction term of estimated inversed Mills ratios and year dummy variables and ρ_t is its coefficient.

The sample of neighbor county pairs is based on the threshold of any positive minimum wage hikes. We reduce the sample by only including the period from 2001 to 2005, and also exclude firms with hiatus periods. Table XIII show the results by whether to use the Heckit approach. Two columns are both based on the same sample. The results show that attrition correction barely affects estimates. The unreported coefficients of inverse Mills ratios are statistically significant in the years of 2001, 2002, and 2003, while the coefficients of other variables remain unchanged.

7.3 Placebos

As a placebo test, we set treatment one-year backward for those treatment counties. These treatment periods are assigned arbitrarily so we call them periods of pseudo treatment. In theory, estimation based pseudo treatment should not lead to same result as real treatment if we have identified real treatment correctly. Table XIV compare the results of three treatment periods. The variable of interest is a dummy variable indicating whether a county experiences a minimum wage hike relative to its neighbor county in that year. Column 1 represents real treatment and replicates column in Table VII. The estimated coefficient is -0.006. As we set treatment periods one year backward, the estimate is 0.003 and statistically significant. Because minimum wage adjustment is hard to be predicted one year before, firm expectations may not be at work in this case.

8 Conclusion

China enacted minimum wage legislation in 1994. It is commonly believed that enforcement of the policy was strengthened after 2004: After this particular time, firms started to feel the pressure of rising labor cost, both from these regulations and from development in the labor market.

In this paper, we study a sample of neighbor county pairs with difference in minimum wage hikes, and find that the average effects of minimum wages on firm employment during the period from 2000-2002 are statistically insignificant from zero, but turn to be negative in 2003, rather in 2004. The year 2004, on the contrary, did not enlarge the negative effect of minimum wages compared with 2003. After 2005, the effect of minimum wages becomes highly significant and more negative. This result roughly shows a lagged effect of enforcement tightening. If we try to divide the sample period into two episodes, the division of pre-tightening of 2000-2004 and post-tightening of 2005-2007 leads to clear-cut results. The elasticity of minimum wages for 2000-2004 is 0.022, not statistically significant; the elasticity for 2005-2007 is -0.103, statistically significant at the 1% level. With the same period division, we study the effect of minimum wage hikes on firm profit margins and employee wages. We find that minimum wage hikes increase both profit margins and employee wages in treatment counties. Therefore, the evidence shows that China's firms might not be worse off when facing an increase in local minimum wages.

The legislative tightening of minimum wage regulation increased the effect of this policy, but the evidence that it did not worsen firm profitability in the following years suggests that government might have accommodated regulation adjustments to protect local firms. Whether this style of regulation is beneficial or distortional is still not clear if we are concerned about social welfare. As for firms, we see that government regulations have not served to hinder their development. As for employees, those who are always at work benefit from minimum wage increases. Those who quit their jobs because of the policy change might be affected in the short run. As we cannot account for job reallocation, we cannot evaluate the long-run effect for those unemployed.

This research of minimum wages on firm employment helps shed light on more recent regulations on China's labor market, such as the labor-contract law being enacted in 2008. There have been heated debates on whether these regulations are so excessive as to deteriorate firm performance in China. This paper shows that labor market regulations are certainly binding but their negative effect on firms can be soothed away by government enforcement in practice.

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Figure II: Neighbor county pairs with difference in minimum wage hikes

The figure shows the trend of mean city annual (effective) minimum wages and mean city nominal wages over 2000-2011.

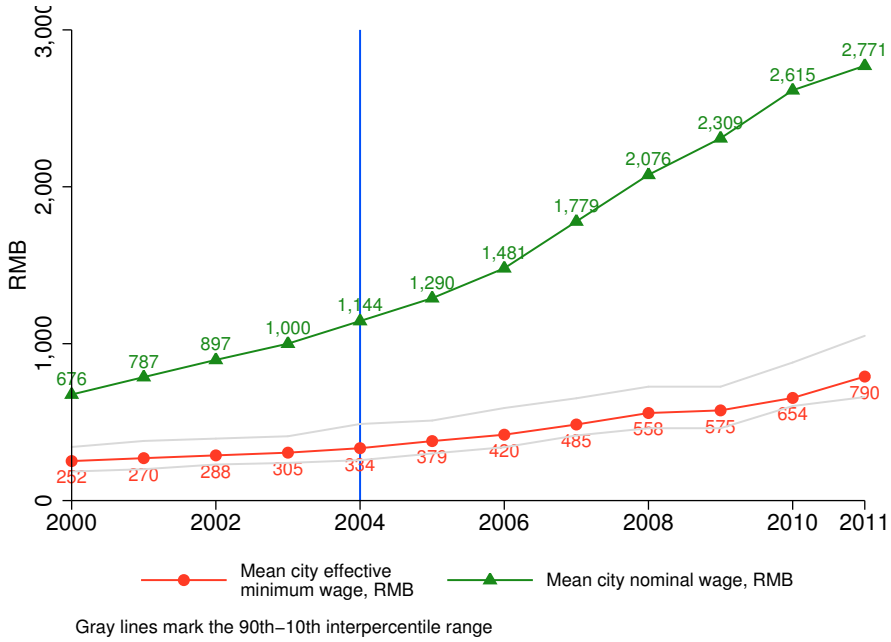

Figure III: Neighbor county pairs with difference in minimum wage hikes

The figure shows the spatial distribution of China's neighbor county pairs with difference more than 30 percent in their minimum wage hikes over 2000-2007.

Figure IV: County minimum wage variations within cities, 1998-2007

The figure shows the spatial distribution of cities according to variations of their county minimum wages. Minimum wages are invariant within a city if the city's minimum wages are same among its counties, and vice versa.

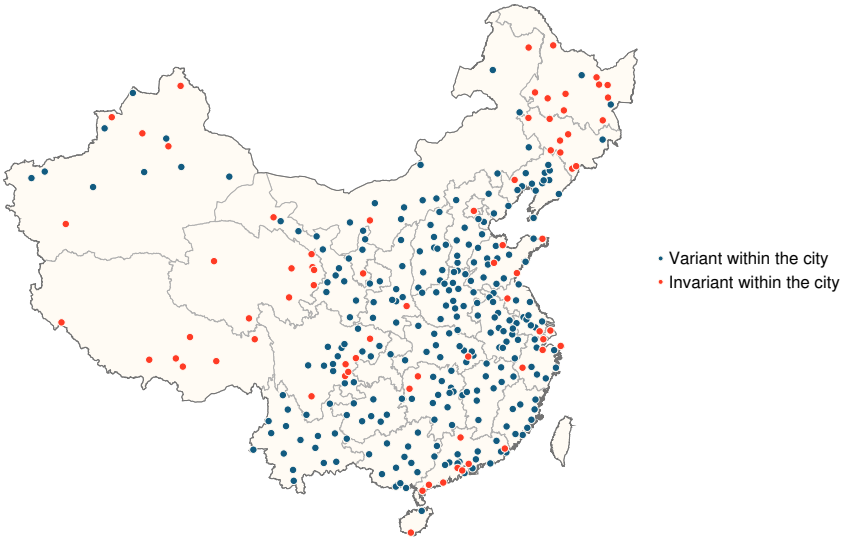

Figure V: Firms paying low than minimum wages, 1998-2007

The figure shows the shares of manufacturing firms in China who paid average wages below city minimum wages. Because firms systematically under-report total wage bills in the survey, one needs to relate these shares to non-compliance with caution.

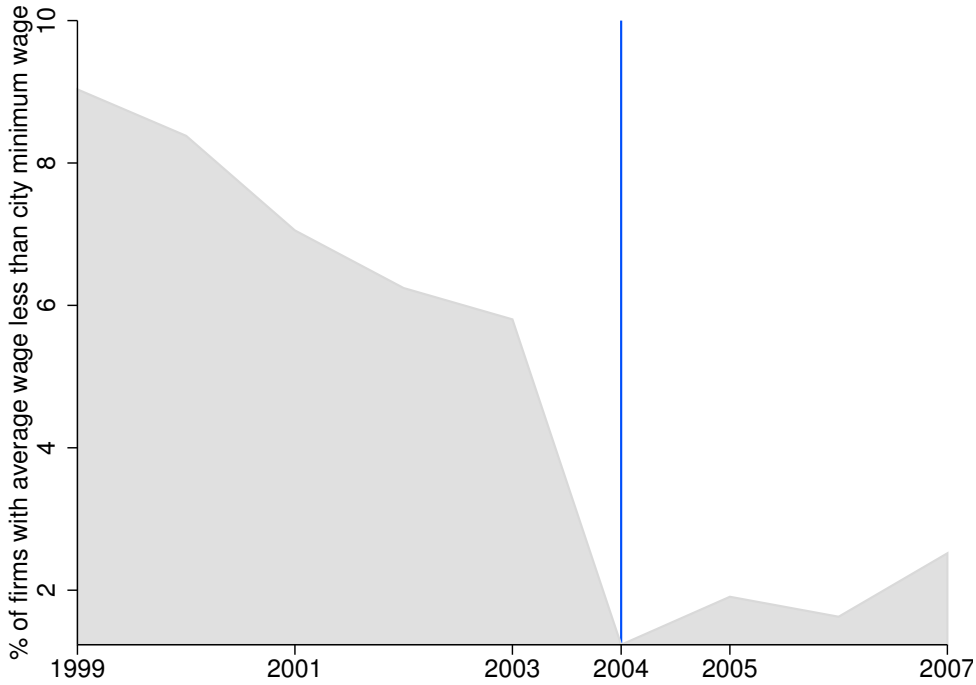

Table I: Minimum Wage Hikes by Year, 1996-2011

This table shows the percentage of counties with minimum wages hikes greater than a certain level in every year from 1996 to 2011. The number of counties in the sample is 2,374.

Year	> 0 (%)	$> 10\%$ (%)	$> 20\%$ (%)
1996	36	25	13
1997	53	34	9
1998	16	13	4
1999	74	71	52
2000	26	22	12
2001	38	24	13
2002	64	38	12
2003	64	27	10
2004	75	42	19
2005	85	59	38
2006	99	46	18
2007	99	65	35
2008	99	80	29
2009	36	8	0
2010	98	80	11
2011	100	97	56

Table II: Minimum Wage Hikes by Size, 2000-2007

This table shows the distribution of minimum wage hikes during 2000-2007. A hike happens if two neighbor counties experience difference in minimum wage adjustment more than 1 percent.

Neighbor county difference in minimum wage hikes	Share
$> 0\%$ - 10%	58%
10% - 15%	14%
15% - 75%	28%

Table III: Summary Statistics of Main Variables

This table shows summary statistics of main variables. Without further note, we tabulate using nominal variables, instead of real variables. The top panel shows statistics for macroeconomic variables at the level of prefectual cities for the period from 1994 to 2011. Wage variables and city GDP are converted to monthly values for comparison. Growth rates are calculated by the difference of logs. The number of prefectural cities and directly controlled municipalities amounts to 337. The middle panel shows in-sample summary statistics for firm employees, monthly employee wages, firm sales, firm export-to-sales ratios, and firm profit-to-sales ratios, during the period from 1998 to 2007. Sales are measured in 1,000 Yuan. Wages are measured in Yuan. The sample consists of the manufacturing firms in the ASIF data who have consecutive presence for at least three years. The bottom panel shows the share distribution of ownership in selected years during 1998-2007.

Variable	Median	Mean	STD	Min	Max
Macroeconomic Variables					
Monthly minimum wage	330	393	205	125	1,266
Monthly wage per employee	934	1,227	862	193	6,319
Monthly GDP per capita	701	1,189	1,359	71	15,361
Growth rate of GDP per capita	0.13	0.13	0.10	-0.89	1.21
Fixed asset investment to GDP	0.38	0.43	0.24	0.01	3.55
GDP share of secondary industry	0.44	0.43	0.14	0.04	1.00
GDP share of tertiary industry	0.35	0.36	0.10	0.05	1.00
Growth rate of FDI	0.11	0.15	0.67	-3.93	10.14
Growth rate of labor	0.01	0.05	0.24	-2.50	3.02
Registered unemployment rate	0.03	0.04	0.02	0.00	0.13
Firm Variables					
Employees	120	285	1,014	2	188,151
Sales (in thousand)	18,426	81,798	732,096	10	187,000,000
Monthly firm employee wage	967	1,205	981	83	7,693
Export/Sales	0.00	0.18	0.36	0.00	1.27
Profit/Sales	0.02	0.01	0.15	-1.14	0.38
Firm Shares over Years					
	1999	2001	2003	2005	2007
State firms	31%	20%	12%	7%	5%
Private firms	50%	59%	65%	71%	72%
HMT firms	11%	12%	12%	11%	11%
Foreign firms	8%	9%	10%	12%	12%

Table IV: Minimum Wage Accounting

This table shows how minimum wages adjust to policy variables. The sample is a unbalanced panel including 346 cities during the period from 1994 to 2011. The dependent variable is the logarithm of annual city minimum wages deflated by provincial CPI. At year t, a county's annual minimum wage is equal to the average of minimum wages that take effect at year t. A city's effective minimum wage averages minimum wages of its counties. Column 1 to column 3 contains results for the period of 1994-2003, and column 4 to column 6 use the sample from 2004 to 2011, the period after the legislative tightening of policy enforcement on minimum wages.

The explanatory variables are grouped into three sets and lagged for one year. The first set measures living cost in a city, which includes the logarithmic variable of city average wages deflated by CPI. The second set of variables considers a city's growth opportunity. These variables are the growth rate of GDP per capita, the logarithm of annual fixed asset investment, GDP shares of the secondary and tertiary industries, and the growth rate of FDI. The third set of variables represent the condition of local labor markets, which include the growth rate of labor employed and the unemployment rate.

The panel estimation uses fixed effects for years and cities. Robust standard errors clustered at the city level are shown in the parentheses underneath the coefficient estimates. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level (two-sided).

	Dependent variable: Log(Minimum Wage)					
	After enforcement tightening			Before enforcement tightening		
	(1)	(2)	(3)	(4)	(5)	(6)
city average wage	2.960***	2.386***	2.386***	−0.210	0.053	0.056
	(0.038)	(0.094)	(0.094)	(0.160)	(0.152)	(0.156)
growth of GDP per capita		−0.068***	−0.069***		−0.029	−0.030
		(0.019)	(0.019)		(0.019)	(0.019)
fixed asset investment		0.069***	0.069***		0.012	0.012
		(0.011)	(0.011)		(0.009)	(0.009)
secondary industry share		0.066	0.066		−0.029	−0.031
		(0.077)	(0.077)		(0.068)	(0.071)
tertiary industry share		0.037	0.033		0.048	0.045
		(0.102)	(0.102)		(0.058)	(0.059)
growth rate of FDI		0.000	0.000		−0.002	−0.002
		(0.002)	(0.002)		(0.002)	(0.002)
growth rate of labor			−0.025			−0.006
			(0.018)			(0.006)
unemployment rate			−0.062			−0.364
			(0.164)			(0.261)
Observations	2768	2600	2600	3385	3173	3173
Cities	346	325	325	346	325	325
Within R-Square	0.88	0.90	0.90	0.84	0.85	0.85
Between R-Square	0.28	0.05	0.05	0.07	0.07	0.09
Overall R-Square	0.08	0.24	0.24	0.45	0.47	0.47
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Table V: Effect of Minimum Wages on Firm Employment

Estimation by different periods

This table estimates the effect of minimum wages on firm employment based on the sample of neighbor county pairs. A county pair is included if any positive difference in minimum wage changes more than 5 percent is observed at the previous period for two neighbor counties. The estimation model is based on equation (3) with GMM-style instruments of one year lag. The whole period is from 2000 to 2007. Column 1-4 estimate the elasticities of minimum wages by using subsamples for each period. Column 5-7 estimate by using the whole sample and interacting the variable of the minimum wage with period dummy variables. Column 1 and 2 divides the whole period into two episodes: pre-tightening from 2000 to 2004 and post-tightening from 2005 to 2007. Alternatively, column 3 and 4 divides the whole period into two episodes: from 2000 to 2003 and from 2004 to 2007. Column 5 and column 6 estimate these two divisions using the whole sample. Column 7 estimates the elasticities of the minimum wage by year using the whole sample. The whole set of firm and macroeconomic variables are controlled for. The coefficients of these variables corresponding to column 1 and column 2 in this table will be reported in column 3 and column 6 in Table VI.

The estimation controls for year dummy variables and minimum-wage determinants. Robust standard errors clustered at the level of county-pairs and provinces separately are shown in the parentheses underneath the coefficient estimates. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level (two-sided).

	Dependent variable L_t: log(employees)						
	Subsamples				Whole sample		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$MW_t \times (< 2005)$	0.022					−0.028	
	(0.021)					(0.020)	
$MW_t \times (\geqslant 2005)$		−0.103***				−0.067***	
		(0.031)				(0.021)	
$MW_t \times (< 2004)$			0.011		−0.040**		
			(0.023)		(0.020)		
$MW_t \times (\geqslant 2004)$				−0.084***	−0.053**		
				(0.028)	(0.021)		
$MW_t \times 2000$							−0.014
							(0.014)
$MW_t \times 2001$							−0.002
							(0.016)
$MW_t \times 2002$							−0.025
							(0.018)
$MW_t \times 2003$							−0.048**
							(0.019)
$MW_t \times 2004$							−0.045**
							(0.021)
$MW_t \times 2005$							−0.083***
							(0.021)
$MW_t \times 2006$							−0.058***
							(0.020)
$MW_t \times 2007$							−0.086***
							(0.021)
Observations	1,482,311	1,710,084	1,147,333	2,045,062	3,192,395	3,192,395	3,192,395

Table VI: Effect of Minimum Wages on Firm Employment

Different sets of city variable controls

This table estimates the effect of minimum wages on firm employment based on the sample of neighbor county pairs. The estimation model is based on equation (3) with GMM-style instruments of one year lag. The dependent variable L_t is the logarithmic number of a firm's employees. Column 1 to column 3 include different sets of city explanatory variables, similarly for column 4 to column 6.

The estimation controls for county-pair by year dummy variables and minimum-wage determinants. Robust standard errors clustered at the level of county-pairs and provinces separately are shown in the parentheses underneath the coefficient estimates. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level (two-sided).

	Dependent variable L_t: log(employees)					
	After enforcement tightening			Before enforcement tightening		
	(1)	(2)	(3)	(4)	(5)	(6)
MW_t	-0.059^{***}	-0.091^{***}	-0.103^{***}	-0.018	-0.022	0.022
	(0.014)	(0.022)	(0.031)	(0.012)	(0.018)	(0.021)
L_{t-1}	0.457^{***}	0.457^{***}	0.458^{***}	0.588^{***}	0.588^{***}	0.587^{***}
	(0.013)	(0.014)	(0.013)	(0.009)	(0.009)	(0.009)
sales_{t-1}	-0.057^{***}	-0.057^{***}	-0.057^{***}	-0.051^{***}	-0.051^{***}	-0.051^{***}
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
SOE_t	0.000	0.000	0.000	0.034^{***}	0.034^{***}	0.034^{***}
	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)
PRV_t	-0.031^{***}	-0.031^{***}	-0.030^{***}	-0.011^{**}	-0.011^{**}	-0.011^{**}
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
HMT_t	0.008^{**}	0.008^{**}	0.008^{**}	-0.001	-0.001	-0.001
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
$\text{profit margin}_{t-1}$	0.073^{***}	0.073^{***}	0.073^{***}	0.087^{***}	0.087^{***}	0.087^{***}
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
$\text{export/sales}_{t-1}$	-0.012^{***}	-0.012^{***}	-0.012^{***}	-0.009^{***}	-0.009^{***}	-0.009^{***}
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
$\text{city average wage}_t$		0.013	-0.007		0.005	0.057^{**}
		(0.022)	(0.030)		(0.020)	(0.028)
industry wage_t		0.051^{***}	0.019^{*}		0.001	-0.001
		(0.010)	(0.011)		(0.003)	(0.004)
$P_{k,t}$			0.105^{*}			-0.062
			(0.055)			(0.042)
$P_{m,t}$			-0.015			-0.033^{***}
			(0.010)			(0.012)
city GDPPC_t			-0.035^{*}			-0.026^{*}
			(0.020)			(0.014)
industry output_t			0.021^{***}			0.005^{***}
			(0.003)			(0.002)
HHI_t			-0.003^{***}			-0.004^{***}
			(0.001)			(0.001)
$\text{labor share}_t^{\mathbf{IND}}$			0.000^{**}			0.000^{*}
			(0.000)			(0.000)
Observations	1,710,084	1,710,084	1,710,084	1,482,311	1,482,311	1,482,311

Table VII: Effect of Minimum Wages on Firm Employment

Comparison between the choice of using county-pair controls

This table estimates the effect of minimum wages on firm employment based on the sample of neighbor county pairs. The estimation model is based on equation (3) with GMM-style instruments of one year lag. Column 1 shows the results with county-pair controls. Column 2 provides the results without controlling for dummy variables of $\mu_p \times \tau_t$, based on the same sample for comparison.

The estimation controls for year dummy variables and minimum-wage determinants. Robust standard errors clustered at the level of county-pairs and provinces separately are shown in the parentheses underneath the coefficient estimates. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level (two-sided).

	Dependent variable L_t: log(employees)	
	(1) Pair dummy	(2) No pair dummy
MW_t	-0.103^{***}	-0.031^{**}
	(0.031)	(0.015)
L_{t-1}	0.458^{***}	0.487^{***}
	(0.013)	(0.016)
sales_{t-1}	-0.057^{***}	-0.062^{***}
	(0.003)	(0.003)
SOE_t	0.000	0.011^{*}
	(0.006)	(0.006)
PRV_t	-0.030^{***}	-0.026^{***}
	(0.005)	(0.004)
HMT_t	0.008^{**}	0.004
	(0.004)	(0.003)
$\text{profit margin}_{t-1}$	0.073^{***}	0.073^{***}
	(0.006)	(0.006)
$\text{export/sales}_{t-1}$	-0.012^{***}	-0.014^{***}
	(0.002)	(0.003)
$\text{city average wage}_t$	-0.007	0.037^{**}
	(0.030)	(0.016)
industry wage_t	0.019^{*}	-0.010
	(0.011)	(0.012)
$P_{k,t}$	0.105^{*}	0.059^{*}
	(0.055)	(0.031)
$P_{m,t}$	-0.015	-0.070^{***}
	(0.010)	(0.009)
city GDPPC_t	-0.035^{*}	0.053^{***}
	(0.020)	(0.011)
industry output_t	0.021^{***}	0.027^{***}
	(0.003)	(0.003)
HHI_t	-0.003^{***}	-0.005^{***}
	(0.001)	(0.001)
$\text{labor share}_t^{\mathbf{IND}}$	0.000^{**}	0.000^{***}
	(0.000)	(0.000)
Observations	1,710,084	1,710,084

Table VIII: Effect of Minimum Wages on Firm Per Employee Wages

This table estimates the effect of minimum wages on firm per employee wages. The estimation model is similar to equation (3) with GMM-style instruments of one year lag. The dependent variable W_t is the log number of a firm's per employee wage. The whole period is from 2000 to 2007. Column 1 shows the effect over 2005-2007. Column 2 shows the effects over 2000-2004.

As a complementary check, the regressions use a similar set of explanatory variables as in Table V except the replacement of the lagged dependent variable and the corresponding instrument.

The estimation controls for year dummy variables and minimum-wage determinants. Export/sales is winsorized 0.5% from the top. Profit margin is winsorized 0.5% at two sides with replacement. Robust standard errors clustered at the firm level are shown in the parentheses underneath the coefficient estimates. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level (two-sided).

	Dependent variable W_t: log(firm average wage)	
	After enforcement tightening	Before enforcement tightening
	(1)	(2)
MW_t	0.349^{***}	0.329^{***}
	(0.049)	(0.023)
W_{t-1}	0.120^{***}	0.195^{***}
	(0.003)	(0.004)
sales_{t-1}	-0.005^{***}	-0.041^{***}
	(0.002)	(0.002)
SOE_t	-0.009	0.019^{***}
	(0.010)	(0.006)
PRV_t	-0.013	-0.003
	(0.008)	(0.005)
HMT_t	0.001	-0.006
	(0.005)	(0.005)
$\text{profit margin}_{t-1}$	0.037^{***}	0.092^{***}
	(0.008)	(0.006)
$\text{export/sales}_{t-1}$	0.004	0.009^{**}
	(0.002)	(0.004)
$\text{city average wage}_t$	0.491^{***}	0.370^{***}
	(0.052)	(0.027)
industry wage_t	0.132^{***}	0.013^{***}
	(0.015)	(0.005)
$\text{city employee wage}_{t-1}$	-0.075^{***}	0.004
	(0.019)	(0.024)
Observations	1,710,084	1,482,311

Table IX: Heterogeneous Effect of Minimum Wages on Firm Employment

Heterogeneous firms with different wage levels

This table estimates the effect of minimum wages on firm per employee wages. The estimation model is similar to equation (3) with GMM-style instruments of one year lag. We divide all firms in a city at one year into ten groups based on their lagged firm wages and estimate the heterogeneous effect of minimum wages. The observations include all firms during the period from 2005 to 2007 in our sample of county pairs. The dependent variable L_t is the logarithmic number of a firm's employees.

The estimation also controls for the full set of firm and city explanatory variables besides year dummy variables same as in Table VI. Export/sales is winsorized 0.5% from the top. Profit margin is winsorized 0.5% at two sides with replacement. Robust standard errors clustered within county pairs are shown in the parentheses underneath the coefficient estimates. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level (two-sided).

	Dependent variable L_t: log(employees)	
	After enforcement tightening	Before enforcement tightening
	(1)	(2)
MW × firm wage (0-10%)	-0.153^{***}	-0.034
	(0.030)	(0.022)
MW × firm wage (10%-20%)	-0.141^{***}	-0.027
	(0.030)	(0.022)
MW × firm wage (20%-30%)	-0.132^{***}	-0.014
	(0.030)	(0.022)
MW × firm wage (30%-40%)	-0.127^{***}	-0.005
	(0.030)	(0.022)
MW × firm wage (40%-50%)	-0.122^{***}	0.003
	(0.030)	(0.022)
MW × firm wage (50%-60%)	-0.116^{***}	0.011
	(0.030)	(0.022)
MW × firm wage (60%-70%)	-0.107^{***}	0.023
	(0.030)	(0.022)
MW × firm wage (70%-80%)	-0.099^{***}	0.037^{*}
	(0.031)	(0.022)
MW × firm wage (80%-90%)	-0.081^{***}	0.058^{***}
	(0.031)	(0.022)
MW × firm wage (90%-100%)	-0.048	0.096^{***}
	(0.031)	(0.022)
Observations	1,710,084	1,482,311

Table X: Heterogeneous Effect of Minimum Wages on Firm Employment

Heterogeneous effect based on various firm characteristics

This table estimates the effect of minimum wages on firm per employee wages. The estimation model is similar to equation (3) with GMM-style instruments of one year lag. We examine how various firm characteristics affect the effect of minimum wages on firm employment. The observations include all firms during the period from 2005 to 2007 in our sample of county pairs. The dependent variable L_t is the log number of a firm's employees.

Column 1 only adds the interaction term of minimum wages with lagged firm wages. In contrast to the results in Table IX, this table only uses interaction terms with continuous variables. Column 2 adds a full set of interaction terms. These interaction terms are constructed with the products of minimum wages with all firm explanatory variables other than the variable of lagged firm employment.

The estimation also controls for the full set of firm and city explanatory variables besides year dummy variables same as in Table VI. Export/sales is winsorized 0.5% from the top. Profit margin is winsorized 0.5% at two sides with replacement. Robust standard errors clustered within county pairs are shown in the parentheses underneath the coefficient estimates. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level (two-sided).

	Dependent variable L_t: log(employees)			
	After enforcement tightening		Before enforcement tightening	
	(1)	(2)	(3)	(4)
$\text{MW}_t \times \text{firm wage}_{t-1}$	0.117^{***}	0.124^{***}	0.004	0.011
	(0.007)	(0.007)	(0.011)	(0.011)
$\text{MW}_t \times \text{sales}_{t-1}$		-0.025^{***}		-0.029^{***}
		(0.003)		(0.004)
$\text{MW}_t \times \text{SOE}_t$		-0.087^{***}		-0.123^{***}
		(0.012)		(0.014)
$\text{MW}_t \times \text{PRV}_t$		0.006		-0.032^{**}
		(0.009)		(0.014)
$\text{MW}_t \times \text{HMT}_t$		-0.076^{***}		-0.005
		(0.012)		(0.014)
$\text{MW}_t \times \text{profit margin}_{t-1}$		0.183^{***}		0.115^{***}
		(0.021)		(0.025)
$\text{MW}_t \times \text{export/sales}_{t-1}$		-0.041^{***}		-0.006
		(0.007)		(0.011)
$\text{MW}_t \times \text{HHI}_t^{\mathbf{IND}}$		-0.006^{**}		0.001
		(0.003)		(0.003)
$\text{MW}_t \times \text{labor share}_t^{\mathbf{IND}}$		-0.000^{***}		-0.000^{**}
		(0.000)		(0.000)
Observations	1,710,084	1,710,084	1,482,311	1,482,311

Table XI: Effect of Minimum Wages on Firm Employment

Comparison between the choice of the treatment variable

This table estimates the effect of minimum wages on firm employment based on the sample of neighbor county pairs. The estimation model is based on equation (3) with GMM-style instruments of one year lag. Column 1 shows the results using a binary variable indicating whether a county experiences a minimum wage hike, while column 2 shows the results using a continuous variable for minimum wages.

The estimation controls for year dummy variables and minimum-wage determinants. Robust standard errors clustered at the level of county-pairs and provinces separately are shown in the parentheses underneath the coefficient estimates. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level (two-sided).

	Dependent variable L_t: log(employees)	
	(1)	(2)
Treat_t	-0.006^{***}	
	(0.002)	
MW_t		-0.103^{***}
		(0.031)
L_{t-1}	0.458^{***}	0.458^{***}
	(0.013)	(0.013)
sales_{t-1}	-0.057^{***}	-0.057^{***}
	(0.003)	(0.003)
SOE_t	0.000	0.000
	(0.006)	(0.006)
PRV_t	-0.031^{***}	-0.030^{***}
	(0.005)	(0.005)
HMT_t	0.007^{**}	0.008^{**}
	(0.004)	(0.004)
$\text{profit margin}_{t-1}$	0.073^{***}	0.073^{***}
	(0.006)	(0.006)
$\text{export/sales}_{t-1}$	-0.012^{***}	-0.012^{***}
	(0.002)	(0.002)
$\text{city average wage}_t$	-0.000	-0.007
	(0.029)	(0.030)
industry wage_t	0.019^{*}	0.019^{*}
	(0.011)	(0.011)
$P_{k,t}$	-0.005	0.105^{*}
	(0.043)	(0.055)
$P_{m,t}$	-0.015	-0.015
	(0.010)	(0.010)
city GDPPC_t	-0.035^{*}	-0.035^{*}
	(0.020)	(0.020)
industry output_t	0.021^{***}	0.021^{***}
	(0.003)	(0.003)
HHI_t	-0.003^{***}	-0.003^{***}
	(0.001)	(0.001)
$\text{labor share}_t^{\mathbf{IND}}$	0.000^{**}	0.000^{**}
	(0.000)	(0.000)
Observations	1,710,084	1,710,084

Table XII: Estimation of Firm Attrition in the ASIF Sample, 2000-2005

This table estimates how firm attrition is determined in the ASIF data for the period of 2000-2005. The binary dependent variable is whether a firm will stay in the sample in the next period. The explanatory variables are firm characteristics, including sales, employment, ownership, profit margins, firm age, and squared firm age. County minimum wages and city fixed effects are used as additional controls. A pooled probit model is estimated separately for each year. Each column shows results for one year denoted on the column header.

Robust standard errors clustered at the city level are shown in the parentheses underneath the coefficient estimates. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level (two-sided).

	Dependent variable: firm stay_{t+1}				
	(1) 2000	(2) 2001	(3) 2002	(4) 2003	(5) 2004
MW_t	-0.127	-0.244^{*}	-0.096	0.373^{***}	0.032
	(0.150)	(0.135)	(0.129)	(0.131)	(0.116)
sales_t	0.180^{***}	0.196^{***}	0.207^{***}	0.068^{***}	0.331^{***}
	(0.011)	(0.010)	(0.011)	(0.008)	(0.021)
L_t	0.047^{***}	0.065^{***}	0.037^{***}	0.047^{***}	-0.005
	(0.011)	(0.011)	(0.011)	(0.010)	(0.013)
SOE_t	-0.199^{***}	-0.190^{***}	-0.238^{***}	-0.427^{***}	0.032
	(0.044)	(0.052)	(0.055)	(0.029)	(0.062)
PRV_t	-0.238^{***}	-0.128^{***}	-0.116^{***}	-0.242^{***}	0.032
	(0.033)	(0.035)	(0.036)	(0.047)	(0.029)
HMT_t	-0.125^{***}	-0.077^{**}	-0.100^{**}	-0.094^{***}	-0.020
	(0.036)	(0.033)	(0.044)	(0.031)	(0.026)
profit margin_t	0.700^{***}	0.733^{***}	0.741^{***}	0.790^{***}	0.667^{***}
	(0.045)	(0.046)	(0.043)	(0.043)	(0.049)
firm age_t	-0.109^{***}	-0.108^{***}	-0.125^{***}	-0.120^{***}	-0.161^{***}
	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)
firm age_t^2	0.004^{***}	0.004^{***}	0.004^{***}	0.004^{***}	0.005^{***}
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	121,449	132,301	144,300	159,496	231,075

Table XIII: Effect of Minimum Wages on Firm Employment

Attrition bias correction

This table estimates the effect of minimum wages on firm employment based on the sample of neighbor county pairs. The estimation model is based on equation (3) with GMM-style instruments of one year lag. The sample period is restricted to 2001-2005. Column 1 uses inverse Mills ratios as additional controls estimated from a first-stage probit regression on a firm's presence in the sample for the next period. Column 2 discards these controls for comparison. The coefficients of inverse Mills ratios are not shown. Those of the year 2001 and 2002 are significantly positive, while that of the year 2003 is significantly negative.

The estimation controls for year dummy variables and minimum-wage determinants. Robust standard errors clustered at the level of county-pairs and provinces separately are shown in the parentheses underneath the coefficient estimates. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level (two-sided).

	Dependent variable L_t: log(employees)	
	(1) Heckit correction	(2) No Heckit correction
MW_t	-0.103^{***}	-0.103^{***}
	(0.031)	(0.031)
L_{t-1}	0.456^{***}	0.458^{***}
	(0.013)	(0.013)
sales_{t-1}	-0.057^{***}	-0.057^{***}
	(0.003)	(0.003)
SOE_t	0.001	0.001
	(0.006)	(0.006)
PRV_t	-0.030^{***}	-0.030^{***}
	(0.005)	(0.005)
HMT_t	0.008^{**}	0.008^{**}
	(0.004)	(0.004)
$\text{profit margin}_{t-1}$	0.074^{***}	0.073^{***}
	(0.006)	(0.006)
$\text{export/sales}_{t-1}$	-0.012^{***}	-0.012^{***}
	(0.002)	(0.002)
$\text{city average wage}_t$	-0.007	-0.007
	(0.030)	(0.030)
industry wage_t	0.019^{*}	0.019^{*}
	(0.011)	(0.011)
$P_{k,t}$	0.105^{*}	0.104^{*}
	(0.055)	(0.055)
$P_{m,t}$	-0.015	-0.015
	(0.010)	(0.010)
city GDPPC_t	-0.034^{*}	-0.035^{*}
	(0.020)	(0.020)
industry output_t	0.021^{***}	0.021^{***}
	(0.003)	(0.003)
HHI_t	-0.003^{***}	-0.003^{***}
	(0.001)	(0.001)
$\text{labor share}_t^{\mathbf{IND}}$	0.000^{**}	0.000^{**}
	(0.000)	(0.000)
Observations	1,708,758	1,708,758

Table XIV: Effect of Minimum Wages on Firm Employment

Placebo test of using pseudo treatment years

This table estimates the effect of minimum wages on firm employment based on the sample of neighbor county pairs. The estimation model is based on equation (3) with GMM-style instruments of one year lag. The sample period is restricted to 2001-2005. Column 1 shows the standard result which replicates column 1 in table XI. Column 2 and column 3 move the period of treatment one year back or ahead.

The estimation controls for year dummy variables and minimum-wage determinants. Robust standard errors clustered at the level of county-pairs and provinces separately are shown in the parentheses underneath the coefficient estimates. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level (two-sided).

	Dependent variable L_t: log(employees)	
	(1)	(2)
Treat_t	-0.006^{***}	
	(0.002)	
Pseudo backward treat_t		0.003^{**}
		(0.002)
L_{t-1}	0.458^{***}	0.458^{***}
	(0.013)	(0.013)
sales_{t-1}	-0.057^{***}	-0.057^{***}
	(0.003)	(0.003)
SOE_t	0.000	0.000
	(0.006)	(0.006)
PRV_t	-0.031^{***}	-0.031^{***}
	(0.005)	(0.005)
HMT_t	0.007^{**}	0.007^{**}
	(0.004)	(0.004)
profit margin_{t-1}	0.073^{***}	0.073^{***}
	(0.006)	(0.006)
$\text{export/sales}_{t-1}$	-0.012^{***}	-0.012^{***}
	(0.002)	(0.002)
city average wage_t	-0.000	-0.001
	(0.029)	(0.029)
industry wage_t	0.019^{*}	0.019^{*}
	(0.011)	(0.011)
$P_{k,t}$	-0.005	0.002
	(0.043)	(0.043)
$P_{m,t}$	-0.015	-0.016
	(0.010)	(0.010)
city GDPPC_t	-0.035^{*}	-0.039^{*}
	(0.020)	(0.020)
industry output_t	0.021^{***}	0.021^{***}
	(0.003)	(0.003)
HHI_t	-0.003^{***}	-0.003^{***}
	(0.001)	(0.001)
labor $\text{share}_t^{\mathbf{IND}}$	0.000^{**}	0.000^{**}
	(0.000)	(0.000)
Observations	1,710,084	1,710,084

Appendix

A Variable List

This list describes and explains all the main variables used in estimation.

- County variable (from the ministry of labor)
  - County is defined as the administrative division at the third level.
  - MW: annual minimum wage. Annual minimum wages are average monthly minimum wages weighted by their durations within a year. Real effective minimum wages, used in the regression at the firm level, are denominated by the 4-digit industry product price index.
- City variables (from the CNKI yearbook database)
  - City is defined as the administrative division at the second level.
  - city average wage: city wage per employee. Employees are those who work at the formal sector in the urban area of each city. City average wages are reported in the database. City total wages and a couple of sources for city total employees are used to replace missing values and outliers of city average wages.
  - city GDPPC: city GDP per capita. GDP per capita are reported in the database. GDP and annual population are used to replace missing values and outliers of GDP per capita. Annual population is calculated as the simple average of city population at the beginning and the end of a year.
  - growth rate of GDPPC: growth rate of city GDP per capita.
  - fixed asset investment: the ratio of fixed asset investment to GDP. This variable is winsorized 1% at two sides with replacement.
  - GDP share of 2nd industry: the ratio of output in the secondary industry to GDP.
  - GDP share of 3rd industry: the ratio of output in the tertiary industry to GDP.
  - growth rate of FDI: growth rate of foreign direct investment. FDI is reported in the database. FDI in the urban area is used to replace missing values and outliers of FDI.
  - growth rate of labor: growth rate of urban and rural labor force. A couple of sources for labor force are reported in the database. The one with the fewest missing values and outliers is used and other sources provide supplementary information.
  - unemployment rate: registered unemployment rate. The number of registered unemployed is reported in the database. It is further denominated by urban labor force, which is measured from a couple of sources reported in the database.
- Province variables (from the CNKI yearbook database)
  - Province is defined as the administrative division at the first level.
  - CPI: consumer price index.
  - P_k: price index of fixed asset investment.
- Industry variables (constructed from the annual survey of industrial firms or other sources)

- industry wage: real industry wage per employee. Industry is classified at the 2-digit level following the code of GB/T4754-2002. Real variables, same in the following, are denominated by the 4-digit industry product price index.
- industry output: real industry output per employee. Industry is classified at the 4-digit level following the code of GB/T4754-2002.
- HHI: Herfindahl index of firm sales in an industry. Industry is classified at the 4-digit level following the code of GB/T4754-2002.
- labor share$^{\mathbf{IND}}$: industry labor income share. It is measured by the ratio of total wages to total gross output at the 4-digit industry level following the code of GB/T4754-2002.
- P_y: price index of industry gross output.
- P_m: price index of intermediate input. It is collected by BBZ (2011).

• Firm variables (from the annual survey of industrial firms)

- L employees: annual firm employment. It is reported as the average of a firm's end-of-month employees in a year.
- S: sales: annual sales revenue from main business.
- W: firm wage per employee. A firm's wage is calculated as the sum of its wage bill, worker benefits, and unemployment insurance. It is common believed employers underreport actual earnings of employees in their income sheet and thus in the dataset. Since there is no evidence that underreporting varies systematically across industries, no adjustment is conducted in this paper. The average wage per employee is a firm's wage denominated by its annual employment. This variable is winsorized 0.5% from the top and dropped if below one thousand Yuan a year.
- HMT: dummy variable of foreign firms controlled by citizens from Hong Kong, Macau, and Taiwan (cf. firms controlled by foreigners not including from HMT)
- SOE: dummy variable of state firms (cf. firms controlled by foreigners not including from HMT)
- PRV: dummy variable of domestic, private firms (cf. firms controlled by by foreigners not including from HMT)
- profit margin: the ratio of profit to sales. This variable is winsorized 0.5% at two sides with replacement.
- export/sales: the ratio of export to sales. This variable is winsorized 0.5% from the top.