The cleansing effect of minimum wage
Minimum wage rules, firm dynamics and aggregate productivity in China*

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Abstract

We study how the 2004 reform of minimum wage rules in China has affected the survival, average wage, employment and productivity of local firms. To identify the causal effect of minimum wage growth, we use firm-level data for more than 160,000 manufacturing firms active in 2003 and complement the triple difference estimates with an IV strategy that builds on the institutional features of the 2004 reform. We find that the increase in city-level minimum wages resulted in lower survival probability for firms that were the most exposed to the reform. For surviving firms, wage costs increased without negative repercussions on employment. The main explanation for this finding is that productivity significantly improved, allowing firms to absorb the cost shock without hurting their employment nor their profitability. At the city-level, our results show that higher minimum wages fostered aggregate productivity growth thanks to productivity improvements of incumbent firms and net entry of more productive ones. Hence, in a fast-growing economy like China, there is a cleansing effect of labor market standards. Minimum wage growth allows more productive firms to replace the least productive ones and forces incumbent firms to strengthen their competitiveness, these two mechanisms boosting the aggregate efficiency of the economy.

Keywords: minimum wages, firm-level performance, aggregate TFP, China.
JEL codes: F10, F14, O14.

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1 Introduction

Can higher minimum wages ensure that economic development benefits the poorest without hurting the growth process itself? The question is controversial in both academic and policy circles. The recent riots in Bangladesh or Cambodia show that the social demand for a better distribution of growth benefits is high in developing countries. In China, polls reveal that concerns about inequality have grown as "roughly eight-in-ten have the view that the rich just get richer while the poor get poorer" (Pewresearch Center, 2012). The debate is also hot in developed economies: renowned politicians and economists have called for a significant rise of minimum wages in the U.S. (Woellert, 2014), as well as Barack Obama in his 2014 State of the Union address. On the other hand, any attempt by authorities to increase wage standards receives the opposition of employer federations. They argue that wage increases will erode their margins, forcing them to fire workers or to relocate entirely their activities in countries with lower wages. The American Chamber of Commerce states for example on its Philippine website that "the relentless upward adjustment in the minimum wages in the Philippines has made minimum wages in the Philippines among the highest minimum wages in ASEAN and caused great harm to the country's domestic and export manufacturing sectors".[1]

The potential adverse effect of minimum wages on economic activity is also highly debated in the academic literature. Recent contributions suggest that minimum wage increases have no significant effect on employment once regional differences in employment growth are controlled for (Dube et al., 2010; Allegretto et al., 2011). However, Neumark et al. (2013) point to serious problems with this research design accounting for spatial heterogeneity; they argue that letting the data identify the appropriate control groups leads to stronger evidence of disemployment effects. Regarding developing countries, recent papers discuss the ambiguous effect of increasing wages for development, warning against the risk of "middle-income trap": some developing countries might not be able to grow beyond a certain income threshold, wages becoming too high at some point for these countries to remain competitive and attractive to firms. Only quality or efficiency improvements could allow them to restore their competitiveness and escape this "middle-income trap" (Eichengreen et al., 2013).

In this paper we rely on detailed firm-level data to investigate these issues both at the micro (firm) and at the aggregate (city) level in the case of China, the fastest growing economy of the past fifteen years. Our empirical strategy exploits a reform of the minimum wage rules passed in 2004; to estimate our effects, we combine a triple difference approach with IV. We use balance-sheet data for more than 160,000 Chinese manufacturing firms active in 2003, and we investigate how the changes in city-level minimum wages imposed by the 2004

[1] http://www.amchamphilippines.com/2013/10/24/jfc-statement-on-minimum-wage-increase/

reform have affected the survival, average wage, employment, productivity and profitability of these firms between 2003 and 2005. We show that the 2004 reform is really binding: the share of firms complying with the local minimum wage or paying wages just above the minimum wage drastically increases after the reform, while no such trend is detected before 2004. We find that a higher minimum wage reduces the survival probability of firms. For surviving firms, wage costs increase without affecting their employment. The main explanation for this finding is that productivity significantly improves, allowing firms to absorb the cost shock without hurting employment nor profitability. We show that these results cannot be accounted for by competing explanations; in particular, substitution of incumbent workers by less-paid/less protected migrants does not seem to be at play. At the city-level, the overall effect of these firm-level adjustments for manufacturing employment is null, entries compensating exits. Moreover, higher minimum wages foster aggregate productivity growth thanks to productivity improvements among incumbent firms and net entry of more productive ones. Hence, in a fast-growing economy like China, there is a cleansing effect of labor market standards. Minimum wage growth allows more productive firms to replace the least productive ones and forces incumbent firms to strengthen their competitiveness, these two mechanisms boosting the aggregate efficiency of the economy.

China is a highly relevant case for several reasons. First, China has become a key player of the global economy; understanding the determinants of its competitiveness and of its industrial dynamics is thus interesting for both developed and developing countries. Moreover, China is the show case in terms of low wages: in 2004, the average monthly wage in manufacturing was equal to 141 dollars in China, versus 342 dollars in Mexico and more than 2,500 dollars in the US.[2]

Second, as shown by Figures 1 and 2 in Appendix, China is characterized by great variations in both the level and the growth-rate of minimum wage across the 261 cities present in our final sample.[3] In 2003, the level of the minimum wage ranged from 170 yuans (20 dollars) in Eerduosi and Hulunbeier (Inner Mongolia) to 600 yuans (72 dollars) in Shenzhen; on the other hand, between 2003 and 2005, it increased by up to 147% (also in Eerduosi and Hulunbeier), while remaining constant in some other cities that already met in 2003 the new standards imposed by the 2004 reform.

Third, the reform passed in 2004 is interesting because it follows a top-down logic. This quasi-natural experiment feature is useful to identify the causal repercussions of minimum wage increases on Chinese firms' activity. Indeed, the 2004 reform expressly sought to increase workers' wages and to promote a convergence process in terms of minimum wage

[2]Authors' calculations based on LABORSTA ILO data: `http://laborsta.ilo.org/STP/guest`.

[3]China is divided into 4 municipalities (Beijing, Tianjin, Shanghai and Chongqing) and 27 provinces which are further divided into prefectures. As is common in the literature, we use the terms city and prefecture interchangeably, even though prefectures include both an urban and a rural part.

between localities. Hence, local governments could choose the level of the minimum wage, but under constraints: after 2004, the city-level minimum wage had to fall within a range of 40-60% of the local average wage, this rule imposing unprecedented increases in minimum wages, in particular in localities where they were initially the lowest. As a result, over a short period of time, minimum wages increased drastically in China (annual growth rate of city-level minimum wages being equal on average to 15% between 2004 and 2007 versus 7% between 2000 and 2003), which contrasts with the small changes generally at play in the existing studies; on the other hand, the dispersion in minimum wages across localities narrowed significantly (the coefficient of variation of city-level minimum wages decreasing by 25% between 2003 and 2007). We exploit these institutional features of the reform to build an IV strategy for the estimation of firm-level and aggregate effects of minimum wage growth.

To run our analysis, we first identify two groups of firms based on how exposed these firms are to the wage shock brought about by the 2004 reform of minimum wage rules. Exposed firms are defined as those firms for which the average wage prior to the reform is lower than the subsequent local minimum wage (as in Harrison and Scorse, 2010 and Draca et al., 2011). Then, we examine the relationship between changes in city-level minimum wage and changes in firm-level outcomes. To do so, we compare exposed and non-exposed firms, controlling for their initial characteristics (size, productivity, export, ownership etc.) and for city-sector fixed effects. This allows us to control for potential correlation between minimum wage growth and local business cycles, firm characteristics and sector characteristics. We focus on the pre- and immediately post-reform period to exploit the massive, but heterogeneous increase in city-level minimum wages induced by the reform. This estimation strategy is close to a triple difference and amounts to comparing the difference in performance growth between exposed and non exposed firms within a given city-sector in cities where the minimum wage grows fast and in cities where it increases more slowly. However, minimum wage may increase faster in cities where the dynamics of low-wage firms is more favorable. To address this remaining endogeneity issue, we propose an IV strategy that builds on the institutional features of the 2004 reform; more specifically, we use the initial level of the minimum wage and the log difference between 0.4 times the city-level average wage in 2005 and the city-level minimum wage in 2003 to extract the causal repercussions of the minimum wage reform on firm-level outcomes. Following a similar instrumentation strategy, we finally provide an analysis of the effect of minimum wage increase on the various margins of city-level employment growth and productivity growth.

This study contributes to the literature along several important dimensions. First, it participates to the debate on the effect of minimum wage on employment. Although increasing wage floors should theoretically raise the wages of the low-paid workers and adversely affect employment (Borjas, 2004), recent evidence (largely based on the US) points to little or no employment effects of minimum wages (see Schmitt, 2013 for a review).[4] However, the question remains highly controversial (see Neumark et al., 2013, for example). We revisit the question focusing on Chinese factories, often considered as the symbol of "low-cost" production. Several studies exist on the Chinese case; they rely on aggregated or semi-aggregated data and find mixed results.[5] We depart from these studies by using much more detailed data: we directly link firm-level outcomes to changes in the local minimum wage. Closest to our study is the firm-level study of Huang et al. (2014) on the link between local minimum wage and employment. While our results are consistent with their finding of an overall very modest effect of minimum wage on employment, our work is different along two important dimensions: we focus on the 2004 reform, which allows us to propose an original instrumentation strategy to carefully address endogeneity issues the studies on minimum wage usually suffer from, and we do not only focus on employment.

By investigating other firm-level outcomes, our work goes beyond the sole effect of minimum wage on employment and tries to understand why we do not find significant disemployment effects of higher minimum wages. Indeed, firms have different ways to adapt to an increase in the level of the minimum wage. Reductions in labor turnover or in profits, improvements in firm-level efficiency or small price increases could limit employment losses for example (Schmitt, 2013; Hirsch et al., 2011). However, rigorous empirical evidence on these channels is scarce (at the notable exception of Draca et al., 2011, who show that British firms absorb the shock induced by the introduction of a national minimum wage in 1999 by reducing their profit margins).[6] In this paper, we propose a careful evaluation of the many ways Chinese firms adjusted to the changes imposed by the 2004 reform, including survival, number of employees, productivity and profitability.

Third, we provide an in-depth analysis of the effect of minimum wage on the various margins of city-level productivity growth. To the best of our knowledge, this is the first

[4] One of the potential explanations for the lack of effect measured in the literature is that the fraction of workers earning the minimum wage in the countries on which the studies are based is very small, i.e. lower than 5% (Neumark et al., 2004), and that the minimum wage adjustments have been rather limited (often lower than the inflation rate). The situation in China is radically different. Since the promulgation of the new minimum wage regulations in 2004, local governments have been required to implement frequent and substantial increases in minimum wages. The latest illustration is the pledge under China's 12^{th} Five-Year Plan to raise minimum wages by at least 20 percent annually, more than doubling them by 2015. Such sizable upward adjustments in minimum wages can be expected to have important repercussions on firms and workers.

[5] Ni et al. (2011) identify some negative effects on overall employment in the prosperous coastal provinces and some positive effects in the less-developed interior provinces. Wang and Gunderson (2011) focus on the employment over population ratio for migrants and find opposite patterns (negative repercussions in the non-coastal zones and no effect in the fast growing Eastern regions). These contrasting results obtained using provincial level data have been confirmed by Fang and Lin (2013) who combine county-level minimum wage panel data with a longitudinal household survey.

[6] However, Draca et al. (2011) fail to identify firm-level adjustments in terms of productivity.

paper to investigate how firm-level adjustments to minimum wage shape aggregate outcomes. Doing so, we contribute to the analysis of the determinants of aggregate efficiency in developing countries. Both firm-level inefficiencies and misallocation of resources across firms have been emphasized as major explanations for the lower aggregate TFP in developing countries (Hsieh and Klenow, 2009). Regarding the first channel, several recent papers show that there is a fixed cost to adopt better practices/technologies. For example, thanks to a randomized experiment, Bloom et al. (2013) show that adopting better management practices significantly increases firm-level productivity of Indian textile firms, the experience suggesting that informational barriers, but also procrastination, prevented firms from adopting the best management practices before. Also based on a randomized experiment, Duflo et al. (2011) show that Kenyan farmers might not use fertilizers even though they are profitable; however, they adopt them when their delivery (and not the fertilizers themselves) is provided for free right after the harvest. This is consistent with a model where agents are present-biased and have a fixed utility cost of adopting fertilizers. Regarding the second channel, Hsieh and Klenow (2009) show that misallocation might be an important source of inefficiency in developing countries; they find that reallocating production factors across firms so as to equalize marginal products to the same extent as in the US would increase aggregate TFP by 30 to 50% in China and by 40 to 50% in India. Khandelwal et al. (2013) argue that institutions might play a role in the allocation of resources. They show that under the Multifiber Arrangement, the allocation of export licenses to textile Chinese exporters was the source of an important misallocation, less productive firms benefitting from more export licenses than more productive ones. In this paper, we analyze the role of labor standards as a determinant of aggregate efficiency. In some developing countries, low wages might allow some inefficient firms to survive and might give incumbent firms little incentive to adopt more efficient but also more costly technologies or management practices; indeed, lower wages reduce the difference in the per-unit production cost incurred with a "high" and a "low" production/management technology. In line with this intuition, we show that increasing wage standards in a fast-growing economy like China improves aggregate efficiency thanks to productivity improvements among surviving firms and net entry of more productive ones. However, minimum wage does not seem to favor reallocation of market shares towards initially more productive incumbent firms.

Finally, we also participate to the literature on the role of labor laws and labor standards in improving the situation of low-paid workers in developing countries. Harrison and Scorse (2010) find that anti-sweatshop activism increases wages without hurting employment in the footwear and textile industry in Indonesia, while high minimum wages tend to reduce employment. We focus here on minimum wage but extend the analysis to the entire manufacturing industry.

The remainder of the paper is structured as follows. The next section describes the Chinese minimum wage system and the effects we can theoretically expect from a minimum wage increase on firm-level and aggregate outcomes. Section 3 presents the data and some descriptive statistics. Section 4 details our empirical strategy. Section 5 reports and discusses firm-level results, while section 6 provides an analysis of the effects of minimum wage on city-level outcomes. Last, Section 7 concludes.

2 Minimum wages in China and potential effect on firm-level and aggregate outcomes

We first present how minimum wages are set in China. To guide our empirical analysis, we then discuss the various effects a minimum wage increase can have on firm-level and aggregate performance from a theoretical viewpoint.

2.1 How minimum wages are set in China?

Minimum wage requirements were first imposed in China in 1993 following the ratification by the country of the International Labor Organization Convention No. 26.

As different parts of the country have very different living standards, China does not have a unique minimum wage level for the entire nation. Minimum wages are set following a decision process that involves both national and local authorities. Each province, municipality, autonomous region, and even each district sets its own minimum wage level according to both local conditions and national guidelines. The fact that municipalities can adjust the level of the minimum wage to local economic conditions ensures spatial variations in the level of minimum wages but gives rise to an endogeneity problem which jeopardizes our capacity to assess the causal effect of minimum wage growth; however, the existence of national guidelines is interesting since it allows to develop instruments to solve this potential endogeneity issue.

Typically, following national requirements, provincial governments set out multiple minimum wage classes for the region as a whole, and each city and county within the region chooses the appropriate minimum wage level based on its own local economic conditions and living standards. For example, in its latest round of minimum wage increases, Zhejiang set out four minimum wage classes for the entire province, with some top-tier cities such as Hangzhou, Ningbo and Wenzhou choosing the highest minimum wage standard (Class A), while other cities, including Jiaxin, Jinhua and Taizhou settled on the next-highest minimum wage level (Class B).

The 1993 rules did not really cover migrants, and penalties in case of non-enforcement were quite low. In the 1990s, minimum wage rules were thus hardly binding in China. In March 2004, the Rules for Minimum Wages (2004 Rules) take effect. They extend minimum wage coverage to migrant workers, and penalties in case of non-enforcement are dramatically increased. One of the explicit aims of the reform is to increase living standards. As a guideline, the 2004 Rules state that the minimum wage for full-time employees should fall within a range of 40-60% of the monthly average local wage. This range is quite close to what we observe in several developed countries that impose minimum wages: in 2011 in France, the monthly minimum wage is roughly equal to 1,100 euros, the average wage being equal to 2,100 euros[7] (the ratio between the two being equal to 52%), while in the US these figures are roughly equal to 1,250 dollars and 3,600 dollars respectively[8] (ratio equal to 35%). The 2004 Rules allowed the Chinese local authorities to adjust the monthly minimum wage for full-time workers by reference to several factors such as the distribution of wages, the evolution of living costs and prices but also the level of economic development and the employment situation. However, crucial for our analysis, they also expressly promoted the convergence of minimum wages across localities and they imposed unprecedented large increases in minimum wages where they were initially the lowest. Hence, as will appear clearly in the statistics presented in Section 4.1, the extent to which the minimum wage rose in a locality after the 2004 reform is inversely related to its initial level.

2.2 Which effects can we theoretically expect from an increase in the level of the minimum wage?

An increase in the level of the minimum wage represents a cost shock for firms (potentially both in terms of fixed and marginal costs of production). Depending on the theoretical framework we have in mind, this shock can have various effects for firms.

In a perfectly competitive framework where the marginal productivity of labor is decreasing and where wages are equal to the marginal productivity of labor, a minimum wage increase should translate into a reduction in the number of workers employed by firms. Moreover, some firms may not be able to sell enough anymore to cover the fixed production cost and will have to shut down.

Predictions would be quite similar in a model where firms are heterogeneous in terms of productivity and compete monopolistically. Firms will entirely pass the higher marginal cost into higher prices for consumers. The overall demand will decrease and the least productive firms will be forced to exit the market, since the will not be able anymore to cover the fixed

[7]See http://www.insee.fr/fr/bases-de-donnees/bsweb/serie.asp?idbank=000879878 and http://www.insee.fr/fr/themes/tableau.asp?reg_id=0&ref_id=NATTEF04155

[8]See http://www.ssa.gov/oact/cola/AWI.html and poverty.ucdavis.edu/faq/what-are-annual-earnings-full-time-minimum-wage-worker

production cost.

These firm-level adjustments should generate unemployment, the labor demand decreasing while wages cannot adjust downward. When workers are heterogeneous, the workers that will be mostly impacted by the layoffs should be the ones with the lowest skills and/or the lowest productivity.

However, several mechanisms could mitigate the disemployment effects of a minimum wage increase.

In set-ups featuring efficiency wage and where workers decide to work or not depending on the level of an outside option, an increase in the level of the minimum wage could improve labor productivity by motivating employees for working harder, and it could also increase employment by favoring labor participation. Also, in imperfect competition models with variable markups, firms might partly absorb the cost shock by reducing their profit margin. This is what Draca et al. (2011) find in the UK.

Finally, a minimum wage increase could also foster firm-level efficiency gains. If we assume that firms have to choose among two production processes, a high-tech one with a low marginal labor requirement but a high fixed adoption cost and a low-tech one, with a high marginal labor requirement but without any fixed adoption cost, an increase in the level of the minimum wage widens the difference in marginal cost between the high-tech and the low-tech technologies; it thus reduces the gap between the two technologies in terms of average per-unit production cost. Then, firms that previously preferred the low technology could find it now profitable to pay the fixed cost for acquiring the high technology. In this framework, low wages act as a disincentive to adopt the most efficient organization or production techniques.

This brief discussion shows that a minimum wage increase might affect various firm-level outcomes: survival, employment, productivity, profitability. Depending on the framework, mechanisms at play might go in opposite directions so that the impact of a higher minimum wage on aggregate employment and productivity is a priori undetermined. The aim of this paper is mainly empirical and we do not test one specific theoretical framework. However, by investigating a wide range of firm-level outcomes, we are able to discuss the possible channels through which Chinese firms have adjusted to the 2004 reform of minimum wage rules.

3 Data and summary statistics

Before discussing our estimation strategy, we briefly present the data we use and some descriptive statistics.

3.1 Data

The main data source is the annual surveys conducted by the National Bureau of Statistics (NBS) in China. Those firm-level surveys include balance-sheet data for all industrial state-owned and non-state firms with sales above 5 millions RMB. Here, industry includes mining, manufacturing and public utilities. Comparison with the full census of industrial firms of 2004 reveals that these firms (accounting for 20% of all industrial firms) roughly employ 70% of the industrial workforce and generate 90% of output and 98% of exports (Brandt et al., 2012).[9] We use information on the number of employees, production, capital, intermediate inputs and wages.[10]

Data on minimum wage at the prefecture level are collected from various official websites such as China Labour Net.[11] The data contain monthly minimum wages for full-time employees and hourly minimum wages for part-time employees by city and year. Since we do not have information on the total number of hours worked, the former are used in our regressions.

Macroeconomic indicators at the city-level such as GDP, population, FDI or university students enrollment will be used as controls in the aggregate regressions and are taken from China Data Online, provided by the University of Michigan.

3.2 Firm level indicators and summary statistics

We do not have information at the worker-level and we thus compute firm-level average wage by dividing the total wage bill by the number of employees.

While we use labor productivity as the main measure of productivity throughout the paper, we also calculate a firm-level TFP index. To do so, we estimate Cobb-Douglas production functions following the approach developed by Levinsohn and Petrin (2003).[12] Intermediate inputs are used as a proxy for omitted variables such as entrepreneur characteristics or macroeconomic shocks anticipated by the entrepreneur but unobserved by the econometrician that could determine both the level of inputs and the level of output. We run the estimations at the 2-digit industry level.

For our empirical strategy, we exploit the 2004 reform of the minimum wage rule: our analysis thus focuses on the evolution of firm-level performance between 2003 and 2005 (but

[9]We follow the routine developed by Brandt et al. (2012) to link firms over time using a unique numerical identifier.

[10]These data aggregate almost perfectly to totals for the same set of variables reported in the Chinese Statistical Yearbook.

[11]This website (http://www.labournet.com.cn/) is established by the Ministry of Labour and reports information on national labour and personnel rules.

[12]In unreported results available upon request, we find that our main message remains when estimating the TFP based on Levinsohn-Petrin or OLS estimator.

our main message holds when restricting the period to 2003-2004 or when enlarging it to 2003-2006).

We clean the data by excluding observations for which value-added, capital or wage is missing, negative or null, as well as firms smaller than 5 employees since the reported average wage may not be reliable for these firms. In order to avoid measurement issues for the aggregate analysis, we also restrict our attention to localities with at least 20 firms in both years, and for which information on GDP, employment, FDI etc. is available. This leaves us with a sample of 261 cities.

Our final sample contains 167,327 firms active in 2003, out of which 21.5% have an average wage that is below the local minimum wage enforced in 2005. As is usually done in the few papers studying the effects of minimum wage with firm-level data (Harrison and Scorse, 2010; Draca et al., 2011), we define these firms as "exposed" firms, since they are the firms that are certainly the most affected by the minimum wage increase. We discuss below the implications of this definition of treatment for our estimations. Table 1 presents statistics on survival rates and changes in average wage for exposed and non-exposed firms separately. The proportion of firms present in 2003 that survive in 2005 is much lower for exposed firms (66%) than for non-exposed firms (78%). Furthermore, wages rose significantly faster between 2003 and 2005 amongst the low-wage exposed firms. Over this period, the growth rate of firm-level average wage is equal to 92 log points in this latter group, while it is equal to 13 log points in the group of firms with a higher initial average wage. The difference is similar if we analyze the evolution of the median wage within each group. These simple descriptive statistics suggest that there is a negative correlation between "exposure" to minimum wage increase and survival, and a positive correlation between "exposure" and firm-level average wage growth over the period. Our econometric analysis will try to assess whether these correlations can be interpreted as causal relationships.

Table 2 goes further in the descriptive analysis by regressing the "exposed" dummy on firm-level characteristics and city-sector fixed effects. Firms which average wage is lower than the subsequent minimum level report quite intuitively lower productivity. They are also less likely to be foreign firms and exporters. The correlation with employment appears sensitive to the way productivity is computed: in column (1), when using the value of output per employee, employment enters negatively while in column (2), when using the Levinsohn-Petrin approach, the coefficient on employment turns out to be positive. The state-ownership dummy is not significant which could reflect two opposite features that compensate each other: on the one hand, state-owned firms are more likely to respect minimum wage laws and hence to pay higher wages than the other firms, but on the other hand, they can afford to pay lower wages while remaining attractive to workers since they provide non-monetary benefits (such as job security). Finally, all else equal (controlling for size and productivity in particular), exposed firms exhibit a higher profitability rate, which might be a direct consequence of the fact that they pay lower wages. All these results are robust to the exclusion of outliers defined as the top and bottom percentile firms in terms of average wage in 2003 (column (3)).

To sum up, the firms that are the most exposed to minimum wage growth between 2003 and 2005 are more likely to be Chinese domestic firms with a low productivity. However, given their productivity and their size, these firms tend to be more profitable, this latter feature being consistent with the fact that they pay lower wages.

4 Empirical strategy

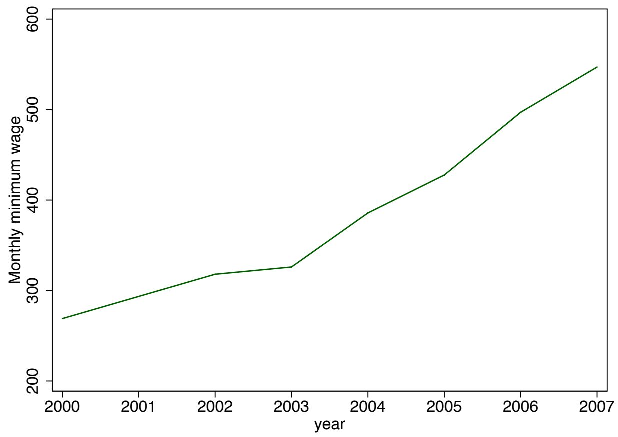
In this section, we show that the 2004 reform of minimum wage rules in China offers a very nice quasi-natural experiment to estimate the effect of minimum wage on firm-level and aggregate outcomes and we then discuss in detail our estimation strategy.

4.1 Why is the 2004 reform a nice experiment to assess the economic effects of a minimum wage increase?

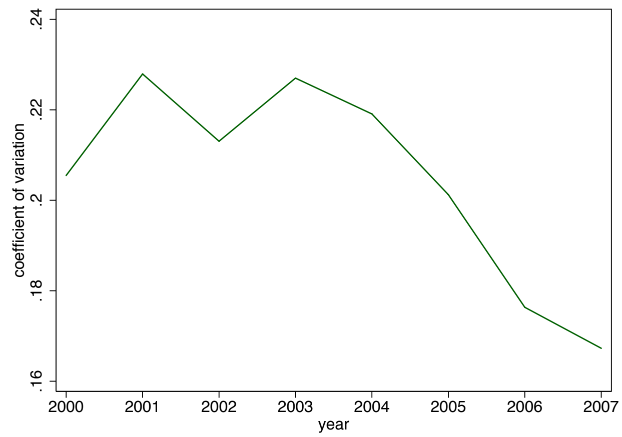
Most studies on the effect of minimum wage have to face two main issues. First, it might be difficult to estimate the effects of a minimum wage increase on firm-level outcomes if these increases are small, or if they occur in all the regions at different but close points in time. In this latter case, the differences in minimum wages across locations remain on average stable over time, offering very short time-spans to estimate any effect in the data (Meer and West, 2013). This is actually often the case in the US and in the UK.

Another issue, more specific to developing countries, is the extent to which minimum wage is enforced. Indeed, massive non-compliance may jeopardize the identification of the minimum wage effects (see for example Strobl and Walsh (2003) in the case of Trinidad and Tobago).

Regarding these two estimation issues, the reform passed in China in 2004 offers a unique design. First, the reform imposes a massive rise in city-level minimum wages. As shown on Figure 1, city-level minimum wages increase all over the 2000-07 period, with a clear acceleration from 2004 onwards. While the annual growth rate of city-level minimum wages was equal to 6.9% on average between 2000 and 2003, it is equal to 15.5% between 2003 and 2007. The other remarkable feature of the post 2004 evolution of minimum wages is the convergence in the level of minimum wage across cities. The right-hand part of Figure 1 shows that the dispersion of city-level minimum wages is quite stable before 2004, with a coefficient of variation equal to 0.23. However, a strong decrease in this dispersion accompanies the reform passed in 2004, the coefficient of variation decreasing to 0.2 in 2005, and to 0.17 in 2007. This suggests that the acceleration in city-level minimum wage growth that we observe from 2004 onwards is concentrated in cities which had the lowest minimum wages before the reform; this is consistent with the convergence objective explicitly pursued by national authorities when implementing the 2004 reform of the minimum wage. This feature will be particularly useful for our instrumentation strategy.



Average minimum wage
(in Yuan)



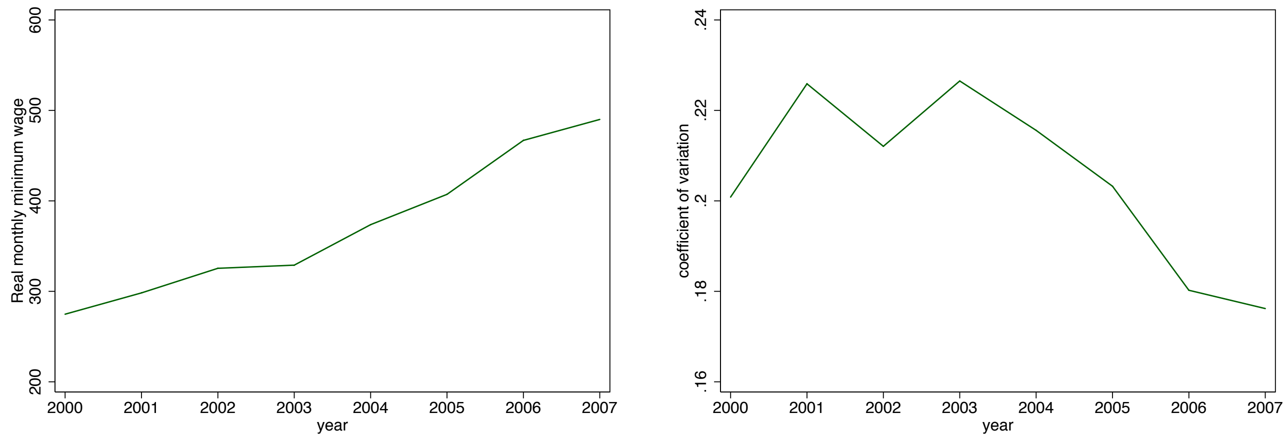
Coefficient of variation
of city-level minimum wage

Figure 1: Evolution of city-level minimum wage

One might worry that these nominal increases in the level of minimum wages are in reality compensated by inflation, imposing in the end very little pressure on firms. In the absence of city-level price indices, we use provincial price indices to compute city-level real minimum wages. As can be seen on Figure 2, the patterns observed for city-level real minimum wages are very similar to those depicted for nominal ones. City-level real minimum wages increase on average by 6.5% before the 2004 reform and by 12.1% after the reform, this post-reform growth being again clearly concentrated in cities with the lowest initial real minimum wage levels. In the econometric analysis, we will use real minimum wage growth.

Even though a minimum wage exists at the city level, there are two reasons why we could not observe any effect in the data: the minimum wage might not be enforced, or it might not be really binding, firm-level wages increasing faster for example than the minimum wage. Enforcement and the degree to which minimum wage is binding are not directly observable. However, several elements tend to show that following the reform, firms are more constrained by minimum wage rules than before.

First, the 2004 reform aimed at increasing firm-level compliance with minimum wage rules by strengthening controls and reinforcing penalties in case of non respect of these



Average real minimum wage (in Yuan)

Coefficient of variation of city-level real minimum wage

Figure 2: Evolution of city-level real minimum wage

rules. Prior to 2004, roughly 88.5% of active firms had an average wage at least equal to the minimum wage imposed in the city where they were located. This share rises to 93.2% after 2004, suggesting that the reform of the minimum wage imposed by the Chinese central government in 2004 is accompanied, at the local level, by a stronger enforcement of the rules.[13]

Moreover, Figure 3 shows that following the 2004 reform, there is a growing concentration of firm-level average wages around the value of the the city-level minimum wage. The upper panel displays the distribution of firm-level wages (left quadrant) and the distribution of the ratio of firm-level wages over the city-level minimum wage (right quadrant) in 2003 and 2005. The lower panel is similar but applies to years 2001 and 2003. Firm-level wages increase markedly between 2003 and 2005, the distribution of individual wages in 2005 being right-shifted as compared to the one observed before the 2004 reform. However, these changes do not occur uniformly along the distribution. The top right quadrant of Figure 3 shows that in 2005, fewer firms declare an average wage lower than the local minimum wage as compared to 2003. On the opposite, more firms now declare an average wage that is equal or slightly higher than the local minimum wage. This concentration of the distribution of firm-level average wages around the city-level minimum wage cannot be attributed to a specific trend, since no such pattern in observed when comparing 2001 and 2003 (bottom right quadrant).

[13]Since we observe in the data the total wage bill and the number of workers, but not the number of hours worked, our measure of average wage at the firm-level is sensitive to the presence of part-time workers in the firms. However, as long as the severity of this issue is constant over time, any change in the share of firms declaring an average wage smaller than the city-level minimum wage can be interpreted as a change in the way this minimum wage is enforced.

Furthermore, Table 3 indicates that the share of firms which average wage is below the city-level minimum wage and the share of firms which average wage is at most equal to 1.15 time the city-level minimum wage both slightly decrease between 2001 and 2003 (from 12.4% to 10.3% and from 5.2% to 4.5% respectively). The picture is different for the period 2003-2005: the share of non complying firms sharply decreases (from 10.3% to 6.3%) while the share of firms which average wage is just above the city-level minimum wage increases (from 4.5% to 5.7%). These evolutions are qualitatively similar for all types of firms (foreign, state owned and domestic private firms).

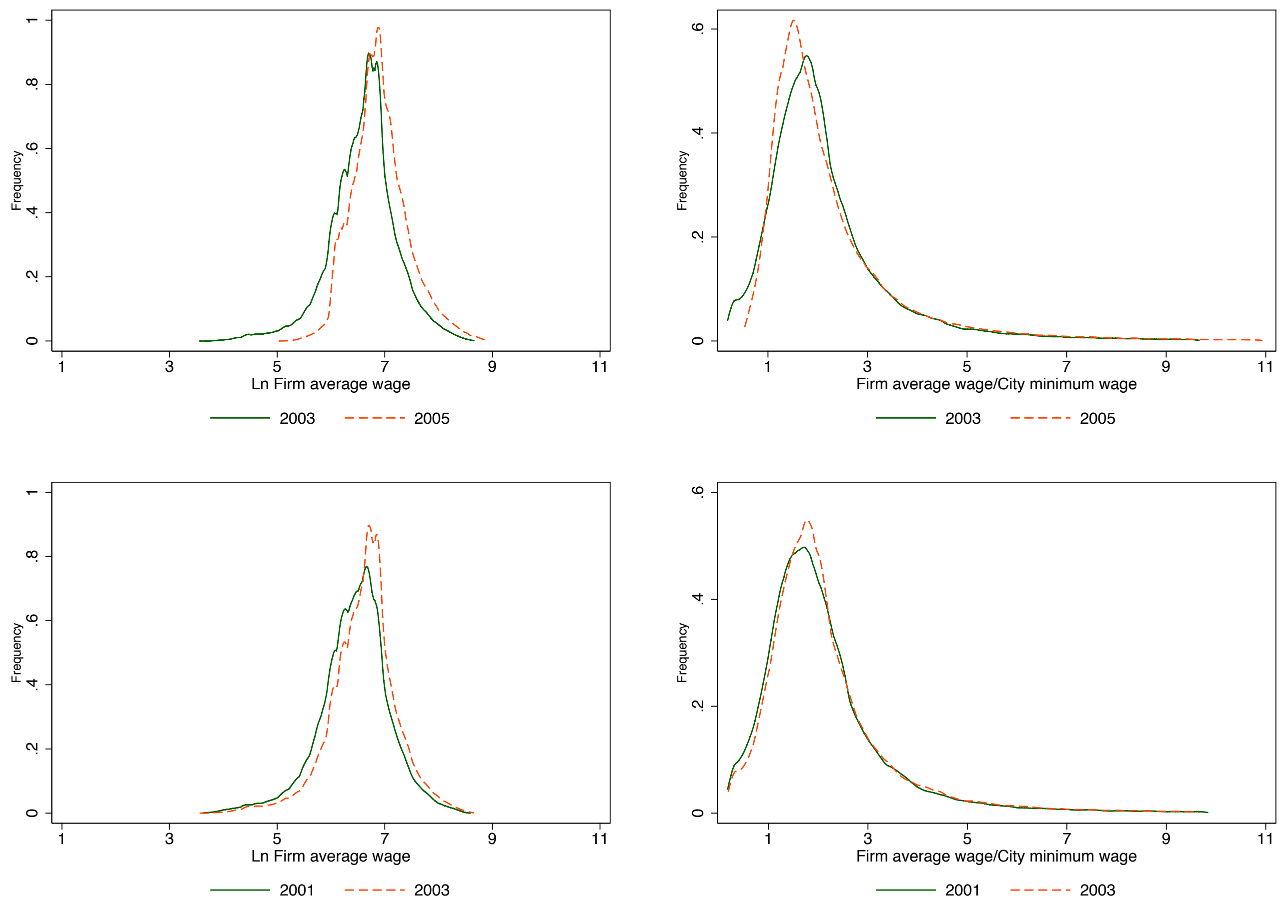


Figure 3: Distribution of firm-level average wage pre and post 2004 reform

Hence, the 2004 reform induces changes in the level of the minimum wage that had never been experienced before, both in nominal and in real terms. Moreover, these changes seem to be binding: the share of complying firms increases sharply, as well as the share of firms paying average wages that are just equal or slightly higher than the minimum wage. If minimum wage significantly affects firm-level outcomes, we can thus reasonably expect to observe these effects in the data following the 2004 reform of minimum wage rules in China.

4.2 Empirical specification and instrumentation

We provide both a micro (firm-level) and a macro (city-level) analysis of the effect of real minimum wage on economic performance. We present here in detail the estimation strategy for the firm-level analysis, the estimation strategy for city-level outcomes being very similar. From now on, we use the expressions "real minimum wage" and "minimum wage" interchangeably.

Whatever the country under study, assessing the effect of a minimum wage increase on firm-level performance requires to address serious endogeneity issues. More specifically, public authorities may fix the level of the minimum wage so as to accompany existing trends in firm-level performance, in particular in terms of employment. The common view is that minimum wage increases will be all the more important that the local economic context is favorable, so as to minimize the potential adverse effects for firms. Hence, there would be an upward-bias in the estimated impact of minimum wage. This concern is particularly strong for China where municipalities can officially adapt the level of the minimum wage to their local economic conditions.

In this paper, we focus on the 2003-05 period since it is directly centered around the year the reform of minimum wage rules was passed in China, but our results are robust to alternative periods of time.[14] We define as "exposed firms" the firms for which we observe an average wage in 2003 that is lower than the local minimum wage in 2005. Indeed, those firms have no other choice than to increase the wages they offer if they want to comply with the new minimum wage imposed in the city where they are located. Note that we do not have information on wages at the worker-level. Hence, our measure of "exposure" to the reform is potentially noisy: in reality, some exposed firms are not exposed to the reform for a fraction of their employees and *vice versa* for non exposed firms. However, this is the best way to define exposure with firm-level data; this is also the logic of the estimation proposed by Harrison and Scorse (2010) and Draca et al. (2011) in their study on Indonesia and UK, and it represents an improvement as compared to aggregate studies. If anything, this measurement error in the treatment variable will tend to bias upward the negative effect we measure on survival and to bias downward the positive effect we find on firm-level average wage and productivity. Regarding firm-level employment growth, things are different and we could under-estimate the negative impact of minimum wage on this outcome. We will show by distinguishing firms that are "strongly exposed" (far away from the future minimum wage) from the other exposed firms that this is not the case.

We then compare the evolution of firm-level performance for "exposed" and "non-exposed" firms within cities and sectors (thanks to city-sector fixed effects). This strategy helps to

[14] In unreported results, which are available upon request, we check that our main message holds when restricting the period to 2003-2004 or when enlarging it to 2003-2006.

account for the fact that cities facing more favorable business cycles might be less reluctant to increase the level of the minimum wage than other cities. Comparing exposed firms to the other firms from the same locality and industry corrects for any specific trend at the local and sectoral level.

We further refine the identification strategy by addressing two possible remaining endogeneity concerns.

First, exposed firms might have specific characteristics that directly affect the evolution of their economic performance. Thanks to our detailed firm-level dataset, we can control for firm-level initial size (in terms of employment), productivity, average wage, exports as well as for the ownership of the firm (state-owned firm, Chinese private firm, foreign firm). These variables not only proxy for the exposure of the firm to minimum wage variations but also help to account for specific firm-level dynamics. In particular, controlling for initial performance allows to capture potential convergence or divergence across firms in terms of performance. Most previous studies relied on more aggregated data and could not control for firm-level characteristics.

Second, local authorities may determine minimum wage increases based on the specific dynamics of low-wage firms, and not based on aggregate business cycles. To control for the potential endogeneity of city-level minimum wage to low-wage firms' performance growth, we need to complement the fixed effect estimation with an IV strategy. The reform of minimum wage rules passed in 2004 partly follows a top-down logic, so that the national government imposes constraints to local authorities in the fixation of their minimum wage. As long as these constraints defined nationally are not designed in order to accommodate specific local conditions, we can use the institutional features of the reform to build our instruments. Two variables appear as natural candidates:

- First, the pre-reform level of the real minimum wage in city c. One of the aims of the reform was to induce convergence in terms of labor regulations across Chinese cities and we have shown that the dispersion in city-level minimum wages sharply decreases after 2004; we should thus expect a negative relationship between the growth rate of the city-level real minimum wage and its level in 2003.

- Second, the log difference between 0.4 times the city-level average wage in 2005 and the city-level minimum wage in 2003. The 2004 reform imposes that the level of the minimum wage falls between 40% and 60% of the local average wage. The higher the difference between the lower bound and the initial city-level minimum wage is, the more important the increase in the local minimum wage should be. We thus expect a positive correlation between the predicted growth rate (based on the lower bound imposed by the reform) and the actual growth rate of the local real minimum wage.

We check the relevance of our instruments by regressing the growth rate of city-level real minimum wages between 2003 and 2005 on these two variables. As expected, between 2003 and 2005, the growth rate of city-level minimum wage is negatively related to the initial level of the minimum wage and positively related to the log difference between 0.4 times the local average wage in 2005 and the initial minimum wage in 2003 (Table 4, column (1)). This remains true when we introduce other city characteristics such as GDP per capita, population, FDI over GDP and ratio of university student enrollment over population to control for specific trends in terms of city-level minimum wage (the results showing that richer and more populated cities tends to experience higher growth of their minimum wage). Quite interestingly, when we run the same regression for the period 2001-2003, the results are quite different: convergence forces across cities in terms of minimum wage are far less important, while the predictive power of the regressions explaining city-level minimum wage growth is much lower. This confirms that the 2004 reform really imposes more constraints on cities where the initial level of the minimum wage was low.

To be valid, our instruments must not be correlated with business cycles affecting specifically low-wage firms. Reassuringly, whatever the specification, city-level minimum wage and predicted minimum wage growth do not significantly explain low-wage firm employment growth between 2003 and 2005 (columns 1 and 2 of Table 5). On the opposite, they are both positively correlated to the the employment dynamics of low-wage firms before the reform (columns 3 and 4 of Table 5).[15] While they are not a formal proof, these results tend to suggest that we cannot reject the exogeneity of our instruments, which will be confirmed by the statistical tests provided in our regression analysis.

All in all, we take these results as evidence that the initial level of minimum wage and the log difference between 0.4 times the city-level average wage in 2005 and the city-level minimum wage in 2003 are good candidates to instrument city-level minimum wage growth.

In the end, we thus estimate a reduced form equation that relates firm-level performance indicators between 2003 and 2005 to the growth rate of the real minimum wage over the same period of time in the city where the firm is located.

Our explained outcomes ΔY^f are successively survival, and for survivors the growth rate of average wage, employment, productivity, profitability and output. Our key explanatory variable is the growth rate of the real minimum wage between 2003 and 2005 in the city c where firm f is located interacted with the "Exposed" dummy. Our specification can be written as follows:

[15] Since roughly 20% of the firms in our sample are considered as "exposed" firms, i.e. have an average wage in 2003 that is lower than the level of the minimum wage in 2005, we consider in this exercise as low-wage firms the first quintile of firms in terms of average wage in each city.

$$\Delta \mathrm{Y}^{f,c,k}_{2003-05} = \alpha \Delta \ln \text{Minimum wage}^{c}_{2003-05} \times \text{Exposed}^{f}_{2003} + \beta Z^{f}_{2003} + \mu_{c,k} + \epsilon^{f}_{c,k} \qquad (1)$$

with Δ denoting the difference between 2003 and 2005. Since we exploit differences between exposed and non-exposed firms within a given city-sector pair, we include city-sector fixed effects $\mu_{c,k}$. Sectors are defined following the Chinese classification of sectors at the 4-digit level. Our final sample covers 480 sectors and 261 cities. Z is the set of firm-level controls that includes proxies for firm level initial performance such as employment, productivity or average wage (measured in 2003), as well as dummies to account for the ownership type (state or foreign) and the export status of the firm. When estimating Equation (1), we thus instrument $\Delta \ln \text{Minimum wage}^{c}_{2003-05} \times \text{Exposed}^{f}_{2003}$ by the interaction between the $\text{Exposed}^{f}_{2003}$ dummy and the two instruments described above.

Given this specification, α is estimated thanks to two sources of variation: the difference in terms of performance growth between exposed and non exposed firms within city-sector pairs, and the difference in terms of real minimum wage growth between cities. This strategy is close to a triple difference approach: we compare the difference in performance growth between exposed and non exposed firms within a given city-sector in cities where the real minimum wage grows fast and in cities where it increases more slowly.

For aggregate outcomes, we use the same estimation strategy, but we do not have to rely on interaction terms and we directly instrument minimum wage growth by city-level initial minimum wage and predicted minimum wage growth (controlling for initial characteristics of cities).

5 Firm-level results

We first analyze the effects of minimum wage growth on firm-level performance.

5.1 Baseline results

We report in Table 6 the results from the estimation of Equation (1) when survival is used as the dependent variable.[16] Estimates with Y^f corresponding to average wage, employment and labor productivity are presented in Tables 7, 8 and 9 respectively.

All the tables follow the same pattern. In column (1), we estimate Equation (1) without the dyadic (city-sector) fixed effects; we include sector dummies only. This specification allows us to measure the correlation between the local minimum wage growth and the evolution

[16] We use here a linear probability model.

of firm-level performance for both exposed and non-exposed firms, controlling for firm-level initial characteristics. Column (2) includes city-sector fixed effects so that we can estimate the effect of minimum wage growth for exposed firms only. Columns (3) and (4) display the two-stage least squares estimates where the change in real minimum wage is instrumented following the strategy described in the previous section. As a precondition for the reliability of the instrumental variable procedure, we check that our instruments are not weak and are valid. All the tests provided at the bottom of the tables do not reject these hypotheses. In column (4) of each table, we more precisely verify that our results are robust when we exclude observations from peripheral regions. The literature on China has emphasized an interior-coast divide. Interior locations are considered to be significantly different from the rest of the country; they have more inward-oriented economies and limited success in attracting foreign investment. We want to ensure that the effects we measure remain unchanged when we drop those peripheral zones, so that the firm-level repercussions of real minimum wage we capture are not driven by these particular locations.

The results reported in Table 6 suggest that an increase in the level of the real minimum wage significantly decreases the survival probability of exposed firms. More precisely, column (1) shows that bigger and more productive firms, as well as foreign and exporting ones, are more likely to survive. Moreover, controlling for firm-level initial characteristics, the survival probability of non-exposed firms tends to be higher in cities where the minimum wage increases faster: these OLS results are consistent with the idea that the local authorities are more likely to increase the minimum wage in cities where local economic conditions are more favorable. On the contrary, exposed firms suffer from the rise in minimum wage: when the minimum wage increases by 10%, their survival probability decreases by 1.4 percentage point as compared to non exposed firms. Introducing city-sector fixed effects in column (2) does not affect this result, while instrumenting minimum wage growth in column (3) tends to reinforce the negative coefficient for exposed firms; this confirms the idea that minimum wage increases have been stronger in cities where low-wage firms benefitted from better shocks. Excluding peripheral regions does not change the results.

In our preferred specification that includes city-sector fixed effects combined with IV (column 3), the estimates imply that a 10 percent rise in minimum wage between 2003 and 2005 reduces the probability that an exposed firm survives by 2.1 percentage point. This effect is economically large: the average survival rate of exposed firms being equal to 0.65 (as reported in Table 1), the elasticity of firm-level survival to real minimum wage is thus equal to -0.32.[17]

The results in Table 7 then show that minimum wage increases are conducive to upward adjustments in the average wage of surviving firms. Theoretically, firms paying their employ-

[17]This elasticity can be computed as follows: $-\frac{2.1}{65} \times 10 = -0.32$.

ees no more than the minimum wage should increase the remuneration of their employees by the exact rate at which the local minimum wage increases. Hence one would expect an elasticity of one. The expected elasticity would by contrast be lower than one for firms paying in 2003 an average wage that lies between the 2003 local minimum wage and the one imposed in 2005. The estimates reported in Table 7 are consistent with this scenario. The coefficient obtained in our preferred specification is 0.36 suggesting that on average, a 10% increase in the local minimum wage leads to a 3.6% increase in the average wage paid by exposed firms. Consequently, the 2004 reform succeeded in increasing significantly wages for workers employed by low-wage firms. This is a further proof that the 2004 reform is binding and puts more pressure on low-wage firms.

We investigate in Table 8 the possible repercussions of this non negligible cost shock on the number of employees in surviving firms. Results in column (1) show that employment growth in non-exposed firms is significantly higher in cities that increase more their minimum wage: this confirms again that local authorities are less reluctant to increase the level of the minimum wage in cities that face better economic conditions. Regarding exposed firms, results are robust across the various columns. We do not find any significant job losses in the exposed firms that remain active: the employment growth of surviving exposed firms is not significantly different from the employment growth of surviving non-exposed ones. Hence, exposed firms do not adjust to the increase in the level of the minimum wage by hiring less or firing more workers than the other firms. Our results confirm in the context of a developing country the conclusions of several papers showing the absence of disemployment effects of minimum wage in developed countries.[18]

The results in Table 9 help understand this apparent paradox that minimum wage increases induce a significant rise in per employee labor cost without hurting employment in surviving firms. Equation (1) is estimated using as the outcome variable the log of average output per employee.[19] As for previous results, the various tests reported at the bottom of the table support the validity of the IV procedure and do not reject the null hypothesis that our instruments are appropriate and not weak. The results show that rises in real minimum wages are associated with significant productivity gains for exposed firms. According to our preferred specification in column (3), a 1% increase in the level of the minimum wage leads to a 0.38% increase in productivity. Interestingly, this elasticity is very close to the elasticity of firm-level average wage to real minimum wage growth (equal to 0.36). For surviving firms, the cost shock brought about by the real minimum wage increase is exactly

[18]Column 4 indicates that the point estimate is virtually unaffected, despite the smaller number of firms, when keeping coastal zones only. In unreported results, available upon request, we also check that there is no significant effect on employment when looking at peripheral zones only.

[19]Table 10 exhibits similar findings when we use total factor productivity (computed following the procedure proposed by Levinsohn and Petrin, 2003) as a dependent variable.

compensated by efficiency gains. Table 1 indicates that real minimum wages between 2003 and 2005 rose, on average, by 20%. Over this same period of time, firm-level productivity increased, on average, by 40 percent for exposed firms. Thus, for exposed firms, the 2004 minimum wage reform can explain about 17% (20×0.38/46) of the increase in productivity over the 2003-05 period. In order to further assess the rise in labor productivity over the period in conjunction with increase in minimum wage, we consider two groups of exposed firms depending on the magnitude of the minimum wage rise of their respective cities. The first group locates in cities where the minimum wage rise corresponds to the national average (20%) while it is greater by one-standard deviation at 31% for the second group. This 11 percentage point difference in minimum wage increase is estimated to lead to a relative rise in labor productivity of 4% in the latter group compared to the former.

We examine in Table 10 the repercussions of the 2004 reform of minimum wage rules on other firm-level outcomes. The odd numbered columns report results based on the OLS specification with city-sector fixed effects while the even numbered columns display our preferred IV estimates. In columns (1) and (2), we present the results obtained for firm-level total factor productivity computed following the procedure proposed by Levinsohn and Petrin (2003). They confirm the above findings that firms exposed to minimum wage rises react by enhancing their productivity. If anything, the elasticity of firm-level TFP to real minimum wage growth is even higher than the elasticity of firm-level labor productivity (0.49 vs 0.36). We have shown that labor productivity gains fully match the increase in wage costs induced by the growth of real minimum wages. Consequently, it does not come as a surprise that firm profitability remains stable following a rise in the level of the real minimum wage, as suggested by columns (3) and (4). Finally, columns (5) and (6) show that real minimum wage growth results in higher output for exposed firms, consistent with the fact that increases in minimum wage generate labor productivity gains without hurting the level of employment of surviving firms. Note that such a result would certainly not hold in an economy that grows slowly. Things are different in a fast growing economy like China, where the additional output produced by exposed firms thanks to their efficiency gains is easily absorbed by the growth of the domestic and foreign demands for Chinese products.

Hence, our results suggest that an important reason why increasing wage floors do not induce adverse effect on employment is the capacity of firms to improve their productivity. However, we reckon that the room for productivity gains may be greater in China than in developed countries (Hsieh and Klenow, 2009, Brandt et al., 2013). Higher wages could for example increase job satisfaction of workers and reduce the turnover of the labor force within the firms, increasing overall productivity. The cost shock could also trigger the adoption of better management or organizations practices that entrepreneurs had not implemented before due to the existence of fixed adoption costs of these practices. Such mechanisms are certainly mostly relevant for developing countries, and the way firms adjust to an increase in the level of the minimum wage might be very different in developed countries. For example, Draca et al. (2011) look at the introduction of the minimum wage in UK and fail to identify significant effects on firm productivity. However, they find a negative effect of minimum wage on firm-level profitability; this explains why they do not find neither any disemployment effect of minimum wage in the UK.

5.2 Robustness checks

In this subsection, we present some robustness checks.

In spite of the introduction of city-sector fixed effects and of our IV strategy, one might still worry that our results are partly explained by specific shocks affecting low-wage firms. These shocks might be directly reflected in the evolution of city-level GDP or could be correlated with the composition of the labor force in terms of skills. In Table 11, we thus alternatively add to our preferred specification GDP growth and the share of low-skilled workers in the total number of manufacturing workers in the city (measured in 2004, the information on the number of skilled and unskilled workers being available in the National Business Surveys only for that year), both interacted with the exposure dummy.[20] Results barely change from a qualitative point of view. Only the effect of minimum wage on firm-level average wage is less precisely estimated when we introduce the interaction between city-level GDP growth and the "exposed" dummy, but the coefficient remains very close to the one obtained in our benchmark specification. We thus conclude that our benchmark specification adequately controls for endogeneity.

In Table 12 we check that our results are robust to the introduction of polynomials of the firm-level average wage (up to order 5). This check is inspired by a standard practice in regression discontinuity design frameworks (Lee and Lemieux, 2010). We introduce polynomials of the variable used to build the treatment variable (here, the firm-level average wage, used to build the exposure dummy) so as to ensure that the coefficient on the treatment variable is not simply capturing a non-linear relationship between the dependent variable (firm-level performance growth) and the variable used to define the treatment. The results remain qualitatively unchanged for all the outcome variables except for the growth rate of firm-level average wage, for which the effect of minimum wage is still positive but insignificant. However, the specification is very demanding in that case. Overall, the results of this table confirm that the coefficient on the interaction between the exposed dummy and real minimum wage growth captures an actual gap in performance growth between exposed and non exposed firms.

[20] GDP growth and the share of unskilled workers in the manufacturing labor force are already taken into account by the city-sector fixed effects.

5.3 Alternative explanations

After having checked that our results are robust to the introduction of additional controls and to various specifications, we now investigate whether the absence of disemployment effect and the productivity-enhancing effect of minimum wage growth can be explained by alternative mechanisms.

In particular, to absorb the cost shock induced by the increase in the local minimum wage, firms could substitute migrants to local workers. Indeed, it is well-know that migrant workers, who are often illegal in the cities where they live, tend to work more hours, to be less paid in terms of hourly wage and to be less covered by welfare and fringe benefits than the others (see Du and Pan, 2009 for example). Migrant workers being overall "cheaper" than local ones, firms could absorb the cost shock by relying more on these workers.

Regarding the implications of such a mechanism for the interpretation of our results, we see two possibilities. First, firms do not declare the (potentially illegal) migrant workers in the National Business Surveys; they only declare the "regular" local workers. In this case, due to the substitution effect, we should observe a negative effect of minimum wage growth on firm-level employment, which is inconsistent with what we find. Second, firms do declare the migrant workers in the National Business Surveys, so that the level of employment of exposed firms does not change relatively to the other firms, but the composition of employment does. Migrants working more hours than local workers, the total number of hours worked increases in exposed firms as compared to non-exposed firms, which explains the increase in labor productivity and in output we measure.

In the data we use, we have information on the fringe benefits (or welfare pay) firms give to their employees. Migrants benefitting less from fringe benefits, if firms substitute migrants to local workers following the 2004 reform, we should observe for exposed firms a relative decrease in the share of welfare pay in overall wages. This is what we investigate in Table 13. Column (1) reports the results of Equation (1) for the total pay per worker computed as the sum of the firm-level average wage and welfare pay per employee. The point estimate is similar to the one we obtained in Table 7 for average wage, suggesting that welfare pay and average wage go hand in hand following the reform. This is confirmed in column (2), which shows that following an increase in the real minimum wage, the ratio of welfare pay over total pay does not change in exposed firms as compared to non-exposed ones.

The analysis of the evolution of city-level unemployment and of the ratio of migrants to residents goes in the same direction. If firms substitute migrants to resident workers, we should observe in cities that increase their minimum wage faster a relative increase in the level of unemployment and/or in the number of migrants as compared to residents in the overall population. Table 14 explores this possibility. We regress in columns (1) and (2) the change in city-level unemployment rate between 2003 and 2005 on local real minimum wage growth and on a bunch of proxies for the initial wealth and attractiveness of the city. In column (2), the growth rate of the city-level minimum wage is instrumented using the two instruments described in section 4.2. Results show that there is no systematic association between the rise in minimum wage and the evolution of the city-level unemployment rate. We do the same in columns (3) to (6) for the ratio of migrants to residents in the overall population and in the working age population respectively. The number of migrants is computed as the number of people without a local residence permit (*hukou*),[21] available at the city-level from the Population censuses hold in 2000 and 2005. Again, our results suggest that there is no significant relationship between the change in the city-level real minimum wage between 2003 and 2005 and the change in the proportion of migrants.

Finally, Du and Pan (2009) study two waves of the China Urban Labor Surveys run in 2001 and 2005 and show that all else equal (in particular controlling for age, skills etc.), the probability that a worker is paid below the level of the hourly minimum wage is higher for migrant workers; however, this difference in probability between migrant and local workers tends to decrease in 2005 as compared to 2001, suggesting that the "cost advantage" of migrant workers drops following the 2004 reform, in line with the objective of the reform to improve the coverage of migrants in terms of labor standards.

Overall, these firm- and city-level results cast serious doubt on the hypothesis that exposed firms substitute migrants to local workers in order to adjust to the minimum wage increase caused by the reform.

Another related concern is the number of hours worked by the employees of exposed firms. In order to absorb the cost shock generated by the 2004 reform, the firms, and especially the ones that are the most exposed to the real minimum wage growth, could ask both their local and migrant workers to increase the number of hours they work. Since we observe the number of employees but not the number of hours worked, it could then be the case that the absence of disemployment effects and the increase in productivity following the 2004 reform reflect in reality an increase in the number of hours worked by the employees of exposed firms. We cannot directly test for such a mechanism. However, Du and Pan (2009) show that the number of hours worked tends to decrease between 2001 and 2005 in China for both migrants and resident workers. In 2001, migrants were working 73.4 hours per week on average in the informal sector and 60.8 hours in the formal sector vs respectively 72.1 and 52.2 hours in 2005. For local workers, these figures are equal to 59.5 in the informal sector and 53.4 hours in the formal sector in 2001, and 44 and 43.5 respectively in 2005. In spite of this decreasing trend in the number of hours worked by employees, our data show that firm-level labor productivity increases on average by 23% over the period. This could not

[21] The hukou is a system of household registration which ties people to their original place of residence, essentially making migrant workers from the countryside illegal immigrants when they move to cities.

be achieved without improvements in firm-level organization or workers' efficiency. In this context the "number of hours" mechanism seems rather implausible.

6 Heterogeneous effect of minimum wage growth

We now go further in the understanding of the effects of the minimum wage by investigating potential heterogeneous effects of the 2004 reform along several dimensions.

First, firms that are more intensive in unskilled workers should be more affected by the increase in the minimum wage. We have information on skills from the National Business Surveys for the year 2004 only. Computing skill intensity at the firm-level would raise endogeneity issues for the econometric analysis. We rather compute the share of unskilled workers in the overall workforce for each city and sector, and we analyze in Table 15 whether the effect of minimum wage growth varies for above- and below the median city-sectors in terms of share of unskilled workers. The results show that there is now significant heterogeneity across city-sectors regarding the effect of minimum wage growth on survival and employment. A rise in the level of minimum wage is equally detrimental to firms in terms of survival probability in low- and high-skill intensive city-sectors, while the effect on the employment of surviving firms is null in both cases. Things are different for firm-level average wage et productivity growth: the elasticity of both variables to minimum wage growth is positive in both types of city-sectors, but it is higher in low-skill intensive city-sectors. This is consistent with the idea that an increase in the level of minimum wage puts more pressure on firms in city-sectors that employ relatively more unskilled workers, who are more likely to earn low wages.

In the same vein, we have already mentioned that since we have firm-level and not worker-level data, it is certainly the case that not all workers in the firms we consider as exposed firms are actually hit by the reform; exposed firms are thus not equally affected by the shock. Hence, we split the sample of exposed firms based on the difference between the level of the city-level minimum wage in 2005 and the firm-level average wage in 2003: the bigger this difference, the more exposed the firms (due to a higher share of low-wage workers or due to lower wages). Results in Table 16 show that the more exposed the firms, the stronger the effects of the reform. Exposed firms for which the difference between the level of the city-level minimum wage in 2005 and the firm-level average wage in 2003 is above the median have a significantly lower probability of survival than firms that are closer to the future wage floor (even though those firms are also negatively impacted by the shock); they also experience higher productivity gains. In terms of average wage, only the most exposed firms experience significant wage increases. Note that these results on the elasticity of firm-level average wage to minimum wage growth point at a compression effect of the minimum wage:

very low wages increase a lot and catch-up low wages, so that the dispersion of wages in the lower tail of the distribution decreases. This is visible on Figure 3 discussed in Section 4.1. This compression effect had already been emphasized by Katz and Krueger (1992) and Lee (1999) for the US. Regarding employment, only the less exposed firms seem to slightly suffer from the minimum wage increase.

Finally, one of the fears of international federations of employers regarding minimum wages in developing countries is that foreign firms may be disproportionately hurt, local authorities being stricter with them. We thus check in Table 17 whether foreign firms react differently to minimum wage growth. This does not seem to be the case, at least regarding survival and firm-level average wage. The elasticity of firm-level productivity to minimum wage seems to be lower for foreign firms, consistent with the fact that inefficiencies will certainly be less important in these firms. Regarding employment, results even tend to show that foreign firms benefit from minimum wage growth (which can happen in theoretical frameworks with efficiency wages for example).

In unreported investigations, we have also checked for the presence of non linearities in the effect of minimum wage growth. We have not detected such patterns: the marginal effect of minimum wage growth tends to remain the same whether the increase in real minimum wage is big or not.

7 Aggregate results

So far, we have investigated the effect of minimum wage on firm-level behavior. Now, we want to figure out how these micro-effects shape macroeconomic outcomes. In particular, does the fact that a minimum wage increase forces some firms to exit the market negatively affect overall employment? How within-firm productivity gains and firm-level entry and exit translate into aggregate productivity gains? We investigate these issues by studying first how the increase in minimum wage induced by the 2004 reform affects city-level economic activity (employment and average productivity). We also distinguish the effect in the various margins of employment change wether they emanate from new firms (firm birth), firm closure (firm death) or surviving firms. In a second step, we decompose city-level productivity growth into its various components (within-firm productivity gains, between-firm reallocation, net entry), and we estimate the impact of a minimum wage increase on each margin.

Our investigation of the effect of a minimum wage increase on city-level aggregate performance relies on the same two instruments (initial minimum wage and predicted minimum wage rise based on the 40% rule) as the ones used for the firm-level analysis.

7.1 Minimum wage and city-level economic activity

In this section, we study the growth of employment and labor productivity at the city-level between 2003 and 2005. The macroeconomic outcomes are computed by taking summing over firms employment and output for each city and each year. Aggregate labor productivity is defined as the city-level ratio of output over employment. For each variable, we then take the log difference. All the regressions control for the initial level of the dependent variable as well as for employment, GDP per capita, population, FDI over GDP ratio and university student enrollment. Hence, potential convergence or divergence forces, as well as differences across cities in terms of size, wealth and attractiveness are controlled for.

The results for the change in city-level employment between 2003 and 2005 are reported in columns (1) and (2) of Table 18 using the OLS and the IV estimator respectively. The results from the IV regression suggest that a rise in the minimum wage has no significant repercussions on employment.[22] In line with the intuition, the comparison between OLS and IV regressions for employment suggests that minimum wage increases have been more substantial in cities facing positive economic shocks. Indeed, instrumentation clearly tends to decrease the coefficient on minimum wage growth, which moves from positive and significant to very close to zero and insignificant. Controlling for endogeneity by instrumenting minimum wage growth is thus crucial. Column (1) of Table 19 reports the IV results for aggregate labor productivity and suggests that rising minimum wages are positively associated with productivity gains.

These aggregate results are fairly consistent with the firm-level estimates provided earlier in Section 5. A rise in the minimum wage is associated with a significant increase in the city-level labor productivity while leaving the overall employment unaffected. While firm-level results showed that higher minimum wages were associated with lower survival probability, the aggregate results report no negative repercussions of these closures for aggregate manufacturing employment. A decomposition of city-level employment growth into job creations, job destructions and employment growth in incumbent firms can help to understand this apparent paradox. The remaining columns of Table 18 report the IV results for the various components of city-level employment growth. These margins are job losses due to exiting firms (column (3)), the within component measured by the change in employment among surviving firms (column (4)) and the total number of jobs created by firms that enter the market between 2003 and 2005 (column (5)). Results in column (4) confirm the absence of employment effect for surviving firms obtained in our firm-level estimates (Table 8). Although only significant at the 10% confidence level, the results in columns (3) and (5) suggest that rising minimum wages are associated with more job destructions, consistent with the negative effect of minimum wage growth on firm survival, but also more job creations. Inter-

[22]The various tests reported at the bottom of the table do not reject the validity of the IV strategy.

estingly, the point estimates on minimum wage growth for job creations and job destructions are very close, equal to 0.6 and 0.7 respectively. Altogether, these results explain the absence disemployment effect of minimum wage at the aggregate level (column 2 of Table **??**). All else equal, it thus seems that higher minimum wage fosters creative destruction within cities so that the overall effect of minimum wage on employment is null. However, note that the absence of disemployment effect of minimum wage growth at the city-level should be taken with caution. The business surveys we use cover 70% of industrial workers. If the industrial firms that are not present in the surveys and service firms react differently to real minimum wage growth, the conclusions could be altered.[23]

Regarding aggregate labor productivity gains, various margins might also be at play: efficiency gains within surviving firms and reallocation between surviving firms on the one hand, and between exiting and entering firms on the other. The next subsection investigates the effect of the 2004 reform on the various margins of city-level average productivity growth. Representativeness of the sample is far less a concern for productivity since the surveys we use cover 90% of overall industrial output.

7.2 Minimum wage and aggregate productivity: a decomposition analysis

To get an estimate of the effect of minimum wage on city-level aggregate productivity, we follow Foster et al. (2001). As summarized in the following equation, we use three categories of firms, *Survivors*, *Exiters* and *Entrants*, to decompose the city-level change in aggregate labor productivity:

[23] In unreported results available upon request, we further decompose the job losses due to exiting firms into the number of exiting firms and their average size in terms of employment and the job creation due to new firms into the number of newly created firms and their average size. The coefficient on minimum wage growth fails to be significant except for the number of newly created firms (positive and significant at the 10% confidence level).

$$\begin{aligned}
\Delta\overline{\mathrm{y}^c}_{2003-05} \quad = \quad & \underbrace{\sum_{\mathrm{f} \in \mathrm{Survivors}_c} \theta^f_{2003}\Delta \mathrm{y}^f_{2003-05}}_{\text{Within}} \\
+ \quad & \underbrace{\sum_{\mathrm{f} \in \mathrm{Survivors}_c} \Delta\theta^f_{2003-05} \times [\mathrm{y}^f_{2003} - \overline{\mathrm{y}^c}_{2003}]}_{\text{Between}} \\
+ \quad & \underbrace{\sum_{\mathrm{f} \in \mathrm{Survivors}_c} \Delta\theta^f_{2003-05} \times \Delta \mathrm{y}^f_{2003-05}}_{\text{Covariance}} \\
+ \quad & \underbrace{\sum_{\mathrm{f} \in \mathrm{Entrants}_c} \theta^f_{2005} \times [\mathrm{y}^f_{2005} - \overline{\mathrm{y}^c}_{2003}] - \sum_{\mathrm{f} \in \mathrm{Exiters}_c} \theta^f_{2003} \times [\mathrm{y}^f_{2003} - \overline{\mathrm{y}^c}_{2003}]}_{\text{Net entry}}
\end{aligned} \tag{2}$$

Average labor productivity in city c in 2003, $\overline{\mathrm{y}^c}_{2003}$, is now measured as the weighted average of the labor productivity y^f_{2003} of firms f located in city c (in log), using as weights θ^f_{2003}, the share of firm f in total employment of city c. The first three components in Equation 2 are computed over the population of surviving firms. The first term is the within component, i.e. the productivity growth of surviving firms between 2003 and 2005 keeping their shares constant. The second term is the between component and accounts for the reallocation of labor between firms with different initial productivities. A positive variation reflects a reallocation of labor from initially less efficient firms to initially more efficient ones (as compared to the city-level average). The third term accounts for the covariance between the within firm changes and the between firm changes. A positive value captures the fact that expanding firms are those which report greater productivity gains. The last two terms are measured on entrants and exiters respectively. They aim at measuring the extent to which the productivity of these two groups compares to the city-level average. A positive value for the entry (exit) component reflects that new entrants (exiters) are systematically more efficient than the local average firm in 2003.

Table 19 reports the IV results for these five margins. Again, we control for various proxies for initial city size, wealth, productivity and attractiveness. Results confirm that cities where the minimum wage increases faster experience the highest productivity gains. The results in column 4 suggest that a 1% difference in the minimum wage growth leads to a 0.34% increase in productivity. Interestingly, this point estimate is very close to the elasticity of firm-level labor productivity to real minimum wage growth (equal to 0.38) obtained in the firm-level sample for survivors (Table 9). If we consider two cities, one where the minimum wage rises at the national rhythm of 20% between 2003 and 2005 and one where the growth is greater by one standard deviation at 31%, labor productivity in the latter is expected to rise by an additional 4%, corresponding to a half-life (amount of time required for a quantity to fall to half its value as measured at the beginning of the time period) of 17 years.

As shown in columns (3) and (5), these aggregate efficiency gains come from two main channels: within-firm efficiency gains among survivors and net entry. This latter channel is suggestive of a cleansing effect of minimum wage: the cost shock induced by the growth of real minimum wage forces the least productive firms to exit and the new entrants to be more productive than the average. However, minimum wage growth does not seem to affect the allocation of employment across incumbent firms: neither the between nor the covariance terms exhibit a significant relationship with the growth of real minimum wage at the city-level. While Hsieh and Klenow (2009) show that the misallocation of resources across incumbent firms is an important source of inefficiency in China, minimum wage regulations do not seem to improve the situation in this respect.

8 Conclusion

This paper shows that higher minimum wages might be a way for developing countries to increase the wages of low-paid workers without necessarily hurting their economy. Exploiting the shock induced by the 2004 reform of minimum wage regulations in China, we study the repercussions of minimum wage growth on firm survival, employment, productivity and profitability. To identify the causal effect of minimum wage growth, we rely on a triple difference estimator combined with an IV strategy that builds on the institutional features of the 2004 reform. We report evidence that survival was reduced, wages were significantly raised and firm productivity was significantly increased, allowing surviving firms to avoid cutting on their labor force or their profits. Moreover, we show that higher minimum wages have boosted city-level aggregate productivity thanks to efficiency improvements among incumbent firms and net entry of more productive ones. Hence, in a fast-growing economy like China suffering from numerous sources of inefficiency, higher labor standards might have a cleansing effect and may be a way to foster the aggregate productivity of the economy.

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Table 1: Summary statistics on exposure and wage evolution

Firm type	Exposed	Non-exposed
Number present in our sample in 2003	35,659	131,668
of which alive in 2005	23,356	102,423
Survival rate	0.66	0.78
Surviving firms		
Mean Δ ln wage$_{2003-05}$	0.92	0.13
Median Δ ln wage$_{2003-05}$	0.73	0.13
s.d. Δ ln wage$_{2003-05}$	0.84	0.50
Mean Δ ln labor productivity$_{2003-05}$	0.46	0.20
s.d. Δ ln labor productivity$_{2003-05}$	0.20	0.65
Mean Δ ln employment$_{2003-05}$	0	0.01
s.d. Δ ln employment$_{2003-05}$	0.62	0.51
All firms		
Mean Δ ln Minimum wage$_{2003-05}$	0.26	0.24
s.d. Δ ln Minimum wage$_{2003-05}$	0.11	0.10
Mean Δ ln Real Minimum wage$_{2003-05}$	0.20	0.19
s.d. Δ ln Real Minimum wage$_{2003-05}$	0.11	0.09

Authors' computations from the 2003 and 2005 NBS annual surveys. Real minimum wages are computed using provincial price indices. Refer to main text for details.

Table 2: Determinants of firm-level exposure to minimum wage changes (2003-05)

Explained variable	Firm exposure dummy		
	(1)	(2)	(3)
Sample			w/o outlier
Ln Firm employment	-0.023^a	0.030^a	-0.024^a
	(0.002)	(0.003)	(0.002)
Ln Firm labor productivity	-0.086^a		-0.081^a
	(0.006)		(0.006)
Ln Firm TFP		-0.070^a	
		(0.005)	
Firm profit over output	0.002^a	0.002^a	0.002^a
	(0.001)	(0.001)	(0.001)
State dummy	-0.014	-0.004	-0.016
	(0.011)	(0.010)	(0.011)
Foreign dummy	-0.045^a	-0.055^a	-0.046^a
	(0.008)	(0.008)	(0.008)
Export dummy	-0.037^a	-0.043^a	-0.036^a
	(0.007)	(0.007)	(0.007)
City-Sector Fixed effects	yes	yes	yes
R-squared	0.05	0.04	0.04
Observations	167,327	164,927	163,738

Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the city level. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level. Exposure is a dummy that indicates that the average wage in the firm in 2003 is lower than the local minimum wage in 2005. All other right-hand side variables are measured in 2003. Firm level productivity is measured alternatively as labor productivity (output per employee) or as TFP (based on Levinsohn-Petrin approach) . Column 3 excludes the top and bottom percentiles of average wage in 2003. Refer to main text for details.

Table 3: Distribution of firm-level average wage to city-level minimum wage ratio in %

	All firms			Foreign firms		
	2001	2003	2005	2001	2003	2005
Share of firms with $\frac{\text{Average wage}}{\text{City minimum wage}}<1$	12.4	10.3	6.3	7.3	6.4	4.5
Share of firms with $1\leq \frac{\text{Average wage}}{\text{City minimum wage}}\leq 1.15$	5.2	4.5	5.7	3.5	3.0	3.6
	State-owned firms			Domestic private firms		
	2001	2003	2005	2001	2003	2005
Share of firms with $\frac{\text{Average wage}}{\text{City minimum wage}}<1$	21.0	17.8	6.7	12.2	10.8	6.7
Share of firms with $1\leq \frac{\text{Average wage}}{\text{City minimum wage}}\leq 1.15$	6.0	5.2	5.6	5.6	4.9	6.4

Authors' computations from the 2001, 2003 and 2005 NBS annual surveys. Refer to main text for details.

Table 4: Determinants of city-level minimum wage growth

Explained variable	Δ Ln real minimum wage			
	2003-05		2001-2003	
	(1)	(2)	(3)	(4)
Ln real Minimum wage	-0.298[a]	-0.489[a]	-0.050[c]	-0.096[b]
	(0.040)	(0.052)	(0.026)	(0.039)
Predicted minimum wage growth	0.164[a]	0.089[c]	0.088[a]	0.058[c]
	(0.047)	(0.047)	(0.029)	(0.031)
Ln GDP per capita		0.064[a]		0.007
		(0.015)		(0.012)
Ln population		0.028[b]		0.027[a]
		(0.011)		(0.008)
FDI over GDP		0.025[c]		-0.001
		(0.015)		(0.002)
Ratio of univ. students over population		-0.001		0.001
		(0.001)		(0.001)
R-squared	0.34	0.40	0.06	0.11
Observations	261	261	258	258

Heteroskedasticity-robust standard errors are reported in parentheses. [a], [b] and [c] indicate significance at the 1%, 5% and 10% confidence level. All right-hand side variables are measured in 2003 in columns (1) and (2) and in 2001 in columns (3) and (4). Predicted minimum wage growth is equal to the log difference between 0.4 times the city-level average wage in 2005 (2003) and the city-level minimum wage in 2003 (2001) in the first (last) two columns.

Table 5: Determinants of city-level employment growth (low-wage firms)

Explained variable	Δ Ln Employment			
	2003-05		2001-2003	
	(1)	(2)	(3)	(4)
Ln Employment in low-wage firms	-0.159[a]	-0.195[a]	-0.075[b]	-0.077[c]
	(0.033)	(0.044)	(0.037)	(0.045)
Ln real Minimum wage	0.230	0.009	0.301[c]	0.313[c]
	(0.182)	(0.219)	(0.172)	(0.182)
Predicted minimum wage growth	0.201	0.093	0.240[c]	0.242[c]
	(0.142)	(0.181)	(0.133)	(0.135)
Ln GDP per capita		0.102		-0.047
		(0.068)		(0.057)
Ln population		0.039		0.008
		(0.044)		(0.042)
FDI over GDP		0.107[c]		0.051[c]
		(0.060)		(0.028)
Ratio of univ. students		-0.001		0.001
over population		(0.001)		(0.001)
R-squared	0.16	0.18	0.04	0.05
Observations	261	261	258	258

Heteroskedasticity-robust standard errors are reported in parentheses. [a], [b] and [c] indicate significance at the 1%, 5% and 10% confidence level. All right-hand side variables are measured in 2003 in columns (1) and (2) and in 2001 in columns (3) and (4). Predicted minimum wage growth is equal to the log difference between 0.4 times the city-level average wage in 2005 (2003) and the city-level minimum wage in 2003 (2001) in the first two (last two) columns.

Table 6: Minimum wage and firm survival

Explained variable	Survival of firm (2003-05)			
	(1)	(2)	(3)	(4)
Estimator			IV estimator	IV estimator w/o periphery
Δ Ln Real Minimum wage 2003-05	0.076^c			
	(0.045)			
Δ Ln Real Minimum wage 2003-05 × Exposed	-0.139^a	-0.136^a	-0.208^a	-0.216^a
	(0.038)	(0.027)	(0.031)	(0.031)
Ln Firm employment	0.078^a	0.081^a	0.081^a	0.081^a
	(0.003)	(0.003)	(0.003)	(0.004)
Ln Firm wage	0.031^a	0.026^a	0.020^a	0.017^a
	(0.005)	(0.004)	(0.004)	(0.005)
Ln Firm labor productivity	0.053^a	0.053^a	0.053^a	0.053^a
	(0.004)	(0.003)	(0.003)	(0.003)
State dummy	-0.120^a	-0.099^a	-0.099^a	-0.084^a
	(0.012)	(0.018)	(0.018)	(0.027)
Foreign dummy	0.014^b	0.027^a	0.028^a	0.030^a
	(0.006)	(0.006)	(0.006)	(0.007)
Export dummy	0.048^a	0.028^a	0.028^a	0.030^a
	(0.005)	(0.005)	(0.005)	(0.005)
Sector Fixed effects	yes	n.a.	n.a.	n.a.
City-Sector Fixed effects	no	yes	yes	yes
R-squared	0.07	0.06	0.06	0.06
Observations	152,226	152,226	152,226	119,663
Underidentification test			63.7^a	40.9^a
First-stage F test of excluded instruments			423^a	443^a
Overidentification Hansen J statistic			0.09	0.52
Chi-sq(1) (p-value)			0.77	0.47

Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the city level. [a], [b] and [c] indicate significance at the 1%, 5% and 10% confidence level. Survival of firm is a dummy which is equal to one when a living firm in 2003 still exists in 2005 in the census. Exposed is a dummy that indicates that the average wage in the firm in 2003 is lower than the local minimum wage in 2005. Δ indicate variation between 2003 and 2005. All other right-hand side variables are measured in 2003. Instruments used in the IV procedure of Δ Ln Minimum wage 2003-05 × Exposed in columns (3) and (4) are the interactions of the local minimum wage in 2003 and the predicted minimum wage change based on the 40% rule (see text) with the exposed dummy. The underidentification test is based on the Kleibergen-Paap rk LM statistic, with [a] indicating that the p-value (Chi-sq(2)) is below 0.01 suggesting that underidentification is rejected. The F test of excluded instruments in the first stage equation is based on the Kleibergen-Paap Wald rk F statistic, with [a] indicating that the p-value is below 0.01 suggesting that the instruments are not weak. The F-statistic on the excluded instruments is largely above 10, the informal threshold suggested by Staiger and Stock (1997) to assess the validity of instruments. The Hansen J statistic is an overidentification test of all instruments, a Chi-sq(1) (p-value) above 0.10 suggests that the model is overidentified and the instruments are exogenous.

Table 7: Minimum wage and firm average wage

Explained variable	Δ Ln Firm average wage (2003-05)			
	(1)	(2)	(3)	(4)
Estimator			IV estimator	IV estimator w/o periphery
Δ Ln Real Minimum wage 2003-05	-0.436[a]			
	(0.104)			
Δ Ln Real Minimum wage 2003-05 × Exposed	0.353[a]	0.262[a]	0.361[a]	0.410[a]
	(0.104)	(0.100)	(0.114)	(0.136)
Ln Firm employment	0.047[a]	0.052[a]	0.052[a]	0.050[a]
	(0.003)	(0.004)	(0.004)	(0.004)
Ln Firm wage	-0.696[a]	-0.770[a]	-0.762[a]	-0.746[a]
	(0.030)	(0.030)	(0.031)	(0.037)
Ln Firm labor productivity	0.098[a]	0.093[a]	0.092[a]	0.094[a]
	(0.006)	(0.005)	(0.005)	(0.006)
State dummy	0.027	0.062[a]	0.061[a]	0.076[a]
	(0.019)	(0.019)	(0.019)	(0.025)
Foreign dummy	0.173[a]	0.168[a]	0.167[a]	0.165[a]
	(0.020)	(0.020)	(0.020)	(0.021)
Export dummy	0.029[a]	0.017[b]	0.017[b]	0.018[b]
	(0.009)	(0.007)	(0.007)	(0.007)
Sector Fixed effects	yes	n.a.	n.a.	n.a.
City-Sector Fixed effects	no	yes	yes	yes
R-squared	0.45	0.47	0.47	0.45
Observations	112,171	112,171	112,171	90,714
Underidentification test			62.5[a]	41.0[a]
First-stage F test of excluded instruments			414[a]	408[a]
Overidentification Hansen J statistic			0.11	0.02
Chi-sq(1) (p-value)			0.73	0.89

Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the city level. [a], [b] and [c] indicate significance at the 1%, 5% and 10% confidence level. Exposed is a dummy that indicates that the average wage in the firm in 2003 is lower than the local minimum wage in 2005. Δ indicate variation between 2003 and 2005. All other right-hand side variables are measured in 2003. Instruments used in the IV procedure of Δ Ln Minimum wage 2003-05 × Exposed in columns (3) and (4) are the interactions of the local minimum wage in 2003 and the predicted minimum wage change based on the 40% rule (see text) with the exposed dummy. The underidentification test is based on the Kleibergen-Paap rk LM statistic, with [a] indicating that the p-value (Chi-sq(2)) is below 0.01 suggesting that underidentification is rejected. The F test of excluded instruments in the first stage equation is based on the Kleibergen-Paap Wald rk F statistic, with [a] indicating that the p-value is below 0.01 suggesting that the instruments are not weak. The F-statistic on the excluded instruments is largely above 10, the informal threshold suggested by Staiger and Stock (1997) to assess the validity of instruments. The Hansen J statistic is an overidentification test of all instruments, a Chi-sq(1) (p-value) above 0.10 suggests that the model is overidentified and the instruments are exogenous.

Table 8: Minimum wage and firm employment

Explained variable	Δ Ln Firm employment (2003-05)			
	(1)	(2)	(3)	(4)
Estimator			IV estimator	IV estimator w/o periphery
Δ Ln Real Minimum wage 2003-05	0.218[a]			
	(0.061)			
Δ Ln Real Minimum wage 2003-05 × Exposed	-0.029	-0.044	-0.045	-0.052
	(0.043)	(0.036)	(0.042)	(0.045)
Ln Firm employment	-0.105[a]	-0.120[a]	-0.120[a]	-0.120[a]
	(0.004)	(0.004)	(0.004)	(0.005)
Ln Firm wage	0.066[a]	0.098[a]	0.097[a]	0.097[a]
	(0.007)	(0.007)	(0.007)	(0.007)
Ln Firm labor productivity	0.106[a]	0.117[a]	0.117[a]	0.115[a]
	(0.005)	(0.005)	(0.005)	(0.006)
State dummy	-0.055[a]	-0.060[a]	-0.060[a]	-0.069[a]
	(0.011)	(0.011)	(0.011)	(0.014)
Foreign dummy	0.014[c]	0.014[c]	0.014[c]	0.018[b]
	(0.008)	(0.007)	(0.007)	(0.007)
Export dummy	0.045[a]	0.047[a]	0.047[a]	0.045[a]
	(0.008)	(0.006)	(0.006)	(0.006)
Sector Fixed effects	yes	n.a.	n.a.	n.a.
City-Sector Fixed effects	no	yes	yes	yes
R-squared	0.11	0.12	0.12	0.12
Observations	112,171	112,171	112,171	90,714
Underidentification test			62.5[a]	41.1[a]
First-stage F test of excluded instruments			428[a]	424[a]
Overidentification Hansen J statistic			1.62	1.87
Chi-sq(1) (p-value)			0.20	0.17

Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the city level. [a], [b] and [c] indicate significance at the 1%, 5% and 10% confidence level. Exposed is a dummy that indicates that the average wage in the firm in 2003 is lower than the local minimum wage in 2005. Δ indicate variation between 2003 and 2005. All other right-hand side variables are measured in 2003. Instruments used in the IV procedure of Δ Ln Minimum wage 2003-05 × Exposed in columns (3) and (4) are the interactions of the local minimum wage in 2003 and the predicted minimum wage change based on the 40% rule (see text) with the exposed dummy. The underidentification test is based on the Kleibergen-Paap rk LM statistic, with [a] indicating that the p-value (Chi-sq(2)) is below 0.01 suggesting that underidentification is rejected. The F test of excluded instruments in the first stage equation is based on the Kleibergen-Paap Wald rk F statistic, with [a] indicating that the p-value is below 0.01 suggesting that the instruments are not weak. The F-statistic on the excluded instruments is largely above 10, the informal threshold suggested by Staiger and Stock (1997) to assess the validity of instruments. The Hansen J statistic is an overidentification test of all instruments, a Chi-sq(1) (p-value) above 0.10 suggests that the model is overidentified and the instruments are exogenous.

Table 9: Minimum wage and firm productivity

Explained variable	Δ Ln Firm labor productivity (2003-05)			
	(1)	(2)	(3)	(4)
Estimator			IV estimator	IV estimator w/o periphery
Δ Ln Real Minimum wage 2003-05	-0.062			
	(0.066)			
Δ Ln Real Minimum wage 2003-05 × Exposed	0.189^a	0.280^a	0.381^a	0.387^a
	(0.059)	(0.053)	(0.056)	(0.061)
Ln Firm employment	0.027^a	0.031^a	0.031^a	0.036^a
	(0.006)	(0.006)	(0.006)	(0.006)
Ln Firm wage	-0.094^a	-0.067^a	-0.059^a	-0.055^a
	(0.011)	(0.012)	(0.012)	(0.013)
Ln Firm labor productivity	-0.248^a	-0.286^a	-0.286^a	-0.273^a
	(0.010)	(0.012)	(0.012)	(0.012)
State dummy	-0.232^a	-0.191^a	-0.191^a	-0.208^a
	(0.021)	(0.025)	(0.025)	(0.035)
Foreign dummy	0.016	0.052^a	0.051^a	0.042^a
	(0.015)	(0.011)	(0.011)	(0.012)
Export dummy	-0.029^a	-0.020^a	-0.019^a	-0.017^b
	(0.009)	(0.008)	(0.007)	(0.008)
Sector Fixed effects	yes	n.a.	n.a.	n.a.
City-Sector Fixed effects	no	yes	yes	yes
R-squared	0.14	0.14	0.14	0.14
Observations	112,171	112,171	112,171	90,714
Underidentification test			62.5^a	41.1^a
First-stage F test of excluded instruments			428^a	423^a
Overidentification Hansen J statistic			1.72	0.37
Chi-sq(1) (p-value)			0.19	0.54

Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the city level. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level. Exposed is a dummy that indicates that the average wage in the firm in 2003 is lower than the local minimum wage in 2005. Δ indicate variation between 2003 and 2005. All other right-hand side variables are measured in 2003. Instruments used in the IV procedure of Δ Ln Minimum wage 2003-05 × Exposed in columns (3) and (4) are the interactions of the local minimum wage in 2003 and the predicted minimum wage change based on the 40% rule (see text) with the exposed dummy. The underidentification test is based on the Kleibergen-Paap rk LM statistic, with ^{a} indicating that the p-value (Chi-sq(2)) is below 0.01 suggesting that underidentification is rejected. The F test of excluded instruments in the first stage equation is based on the Kleibergen-Paap Wald rk F statistic, with ^{a} indicating that the p-value is below 0.01 suggesting that the instruments are not weak. The F-statistic on the excluded instruments is largely above 10, the informal threshold suggested by Staiger and Stock (1997) to assess the validity of instruments. The Hansen J statistic is an overidentification test of all instruments, a Chi-sq(1) (p-value) above 0.10 suggests that the model is overidentified and the instruments are exogenous.

Table 10: Minimum wage and other firm-level outcomes

Explained variable	Δ Firm outcome (2003-05)					
	(1)	(2)	(3)	(4)	(5)	(6)
Firm outcome	Ln TFP		profit over output		Ln output	
	OLS	IV	OLS	IV	OLS	IV
Δ Ln Real Minimum wage 2003-05 × Exposed	0.329[a]	0.488[a]	0.114	0.157	0.236[a]	0.336[a]
	(0.085)	(0.100)	(0.096)	(0.135)	(0.055)	(0.054)
Ln Firm employment	0.188[a]	0.189[a]	0.006[c]	0.006[c]	-0.089[a]	-0.089[a]
	(0.011)	(0.011)	(0.004)	(0.004)	(0.007)	(0.007)
Ln Firm wage	0.111[a]	0.125[a]	0.019	0.023	0.030[b]	0.039[a]
	(0.021)	(0.022)	(0.018)	(0.021)	(0.012)	(0.012)
Ln Firm TFP	-0.435[a]	-0.436[a]				
	(0.013)	(0.013)				
Ln Firm labor productivity			0.030[b]	0.030[b]	-0.169[a]	-0.169[a]
			(0.012)	(0.012)	(0.011)	(0.011)
Firm profit over output			-0.849[a]	-0.849[a]		
			(0.131)	(0.131)		
State dummy	-0.336[a]	-0.337[a]	-0.311	-0.311	-0.251[a]	-0.251[a]
	(0.024)	(0.024)	(0.208)	(0.208)	(0.022)	(0.022)
Foreign dummy	0.077[a]	0.076[a]	0.023	0.022	0.065[a]	0.065[a]
	(0.015)	(0.014)	(0.022)	(0.022)	(0.013)	(0.013)
Export dummy	0.017[c]	0.017[c]	0.015	0.015	0.027[a]	0.027[a]
	(0.010)	(0.010)	(0.015)	(0.015)	(0.010)	(0.010)
City-Sector Fixed effects	yes	yes	yes	yes	yes	yes
R-squared	0.17	0.17	0.01	0.01	0.05	0.05
Observations	110,556		112,171		112,171	
Underidentification test		62.6[a]		62.5[a]		62.5[a]
First-stage F test of excluded instruments		431[a]		428[a]		428[a]
Overidentification Hansen J statistic		0.19		0.30		0.06
Chi-sq(1) (p-value)		0.66		0.58		0.81

Labor productivity is computed as output value per employee. Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the city level. [a], [b] and [c] indicate significance at the 1%, 5% and 10% confidence level. Exposed is a dummy that indicates that the average wage in the firm in 2003 is lower than the local minimum wage in 2005. Δ indicate variation between 2003 and 2005. All other right-hand side variables are measured in 2003. Instruments used in the IV procedure of Δ Ln Minimum wage 2003-05 × Exposed in columns (2), (4) and (6) are the interactions of the local minimum wage in 2003 and the predicted minimum wage change based on the 40% rule (see text) with the exposed dummy. The underidentification test is based on the Kleibergen-Paap rk LM statistic, with [a] indicating that the p-value (Chi-sq(2)) is below 0.01 suggesting that underidentification is rejected. The F test of excluded instruments in the first stage equation is based on the Kleibergen-Paap Wald rk F statistic, with [a] indicating that the p-value is below 0.01 suggesting that the instruments are not weak. The F-statistic on the excluded instruments is largely above 10, the informal threshold suggested by Staiger and Stock (1997) to assess the validity of instruments. The Hansen J statistic is an overidentification test of all instruments, a Chi-sq(1) (p-value) above 0.10 suggests that the model is overidentified and the instruments are exogenous.

Table 11: Robustness checks: city-level controls

Explained variable	Δ Firm outcome (2003-05)									
Estimator	IV estimator									
Outcome	Survival		Ln average wage		Ln Employment		Ln labor productivity		Profit over output	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Δ Ln Real Minimum wage 2003-05 × Exposed	-0.175^a	-0.131^b	0.271	0.646^a	0.005	0.047	0.366^a	0.266^b	0.137	0.067
	(0.053)	(0.066)	(0.179)	(0.190)	(0.068)	(0.085)	(0.135)	(0.110)	(0.140)	(0.097)
Δ Ln city GDP per capita × Exposed	-0.022		0.061		-0.034		0.010		0.010	
	(0.031)		(0.073)		(0.038)		(0.080)		(0.014)	
Ln city skill intensity × Exposed		0.126		0.478^b		0.154		-0.191		-0.142^c
		(0.105)		(0.238)		(0.124)		(0.162)		(0.080)
Ln Firm employment	0.081^a	0.081^a	0.052^a	0.052^a	-0.120^a	-0.120^a	0.031^a	0.031^a	0.001	0.001
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)	(0.006)	(0.004)	(0.004)
Ln Firm wage	0.020^a	0.020^a	-0.761^a	-0.763^a	0.097^a	0.097^a	-0.059^a	-0.058^a	0.019	0.019
	(0.004)	(0.004)	(0.031)	(0.031)	(0.007)	(0.007)	(0.012)	(0.011)	(0.020)	(0.021)
Ln Firm labor productivity	0.053^a	0.053^a	0.092^a	0.092^a	0.117^a	0.117^a	-0.286^a	-0.286^a	0.012	0.012
	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)	(0.012)	(0.012)	(0.010)	(0.010)
Export dummy	0.028^a	0.028^a	0.017^b	0.017^b	0.047^a	0.047^a	-0.019^a	-0.019^a	0.021	0.021
	(0.005)	(0.005)	(0.007)	(0.007)	(0.006)	(0.006)	(0.007)	(0.008)	(0.017)	(0.017)
State dummy	-0.098^a	-0.098^a	0.062^a	0.062^a	-0.061^a	-0.060^a	-0.193^a	-0.192^a	-0.267	-0.267
	(0.018)	(0.018)	(0.019)	(0.018)	(0.011)	(0.011)	(0.025)	(0.025)	(0.200)	(0.199)
Foreign dummy	0.028^a	0.028^a	0.167^a	0.167^a	0.014^c	0.014^c	0.051^a	0.051^a	0.026	0.026
	(0.006)	(0.006)	(0.020)	(0.020)	(0.007)	(0.007)	(0.011)	(0.011)	(0.022)	(0.022)
City-Sector Fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
R-squared	0.06	0.06	0.47	0.47	0.12	0.12	0.14	0.14	0.00	0.00
Observations	152,066	152,226	112,079	112,171	112,079	112,171	112,079	112,171	112,079	112,171
Underidentification test	35.6^a	35.6^a	35.6^a	35.6^a	35.6^a	35.6^a	35.6^a	35.6^a	35.6^a	35.6^a
First-stage F test of excluded instruments	112^a	112^a	112^a	112^a	112^a	112^a	112^a	112^a	112^a	112^a
Overidentification Hansen J statistic	0.07	0.01	0.17	0.06	1.70	2.18	1.89	2.53	0.69	0.42
Chi-sq(1) (p-value)	0.80	0.94	0.68	0.80	0.19	0.14	0.17	0.11	0.41	0.52

Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the city level. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level. Exposed is a dummy that indicates that the average wage in the firm in 2003 is lower than the local minimum wage in 2005. Δ indicate variation between 2003 and 2005. All other right-hand side variables are measured in 2003. Instruments used in the IV procedure of Δ Ln Minimum wage 2003-05 × Exposed are the interactions of the local minimum wage in 2003 and the predicted minimum wage change based on the 40% rule (see text) with the exposed dummy. The underidentification test is based on the Kleibergen-Paap rk LM statistic, with ^{a} indicating that the p-value (Chi-sq(2)) is below 0.01 suggesting that underidentification is rejected. The F test of excluded instruments in the first stage equation is based on the Kleibergen-Paap Wald rk F statistic, with ^{a} indicating that the p-value is below 0.01 suggesting that the instruments are not weak. The F-statistic on the excluded instruments is largely above 10, the informal threshold suggested by Staiger and Stock (1997) to assess the validity of instruments. The Hansen J statistic is an overidentification test of all instruments, a Chi-sq(1) (p-value) above 0.10 suggests that the model is overidentified and the instruments are exogenous.

Table 12: Robustness checks: wage polynomial

Explained variable	Δ Firm outcome (2003-05)				
Estimator	IV estimator				
Outcome	Survival	Ln av. wage	Ln Employment	Ln labor productivity	Profit over output
	(1)	(2)	(3)	(4)	(5)
Δ Ln Real Minimum wage 2003-05 $\times$ Exposed	-0.128^a	0.070	-0.044	0.155^a	0.045
	(0.031)	(0.047)	(0.048)	(0.055)	(0.066)
Ln Firm average wage	0.023	-0.906^a	0.268	-0.050	-0.157
	(0.041)	(0.162)	(0.280)	(0.216)	(0.117)
Ln Firm average wage^2	-0.089^a	0.096	-0.181	0.223^b	0.164^c
	(0.017)	(0.115)	(0.124)	(0.105)	(0.099)
Ln Firm average wage^3	0.028^a	-0.058^c	0.046^c	-0.082^a	-0.045^c
	(0.004)	(0.031)	(0.026)	(0.023)	(0.027)
Ln Firm average wage^4	-0.003^a	0.009^a	-0.005^c	0.010^a	0.005^c
	(0.001)	(0.003)	(0.003)	(0.002)	(0.003)
Ln Firm average wage^5	0.0001^a	-0.0001^a	0.0001^c	-0.0001^a	-0.0001^c
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln Firm employment	0.080^a	0.048^a	-0.121^a	0.030^a	0.001
	(0.003)	(0.003)	(0.004)	(0.006)	(0.003)
Ln Firm labor productivity	0.053^a	0.077^a	0.115^a	-0.292^a	0.010
	(0.003)	(0.005)	(0.005)	(0.011)	(0.009)
Exporting firm	0.028^a	0.013^b	0.046^a	-0.021^a	0.021
	(0.005)	(0.006)	(0.006)	(0.007)	(0.016)
State dummy	-0.097^a	0.041^b	-0.062^a	-0.198^a	-0.268
	(0.018)	(0.017)	(0.011)	(0.025)	(0.201)
Foreign dummy	0.030^a	0.137^a	0.011	0.040^a	0.022
	(0.006)	(0.016)	(0.007)	(0.010)	(0.019)
City-Sector Fixed effects	yes	yes	yes	yes	yes
R-squared	0.06	0.49	0.12	0.15	0.00
Observations	152,226	112,171	112,171	112,171	112,171
Underidentification test	66.8^a	67.9^a	67.9^a	67.9^a	67.9^a
First-stage F test of excluded instruments	399^a	397^{aa}	397^a	397^a	397^a
Overidentification Hansen J statistic	0.07	0.44	1.48	2.45	0.61
Chi-sq(1) (p-value)	0.79	0.51	0.22	0.12	0.44

Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the city level. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level. Exposed is a dummy that indicates that the average wage in the firm in 2003 is lower than the local minimum wage in 2005. Δ indicate variation between 2003 and 2005. All other right-hand side variables are measured in 2003. Instruments used in the IV procedure of Δ Ln Minimum wage 2003-05 $\times$ Exposed are the interactions of the local minimum wage in 2003 and the predicted minimum wage change based on the 40% rule (see text) with the exposed dummy. The underidentification test is based on the Kleibergen-Paap rk LM statistic, with ^{a} indicating that the p-value (Chi-sq(2)) is below 0.01 suggesting that underidentification is rejected. The F test of excluded instruments in the first stage equation is based on the Kleibergen-Paap Wald rk F statistic, with ^{a} indicating that the p-value is below 0.01 suggesting that the instruments are not weak. The F-statistic on the excluded instruments is largely above 10, the informal threshold suggested by Staiger and Stock (1997) to assess the validity of instruments. The Hansen J statistic is an overidentification test of all instruments, a Chi-sq(1) (p-value) above 0.10 suggests that the model is overidentified and the instruments are exogenous.

Table 13: Alternative explanations: minimum wage, average wage and welfare pay

Explained variable	Δ Firm outcome (2003-05)	
Estimator	IV estimator	
Outcome	Per employee	
	Ln Total pay (wage+welfare)	Share of welfare pay over total pay
	(1)	(2)
Δ Ln Real Minimum wage 2003-05 × Exposed	0.372[a]	-0.006
	(0.113)	(0.005)
Ln Firm employment	0.054[a]	0.003[a]
	(0.004)	(0.001)
Ln Firm average total pay	-0.749[a]	0.005[a]
	(0.032)	(0.001)
Share of welfare pay over total pay		-0.857[a]
		(0.014)
Ln Firm labor productivity	0.095[a]	0.004[a]
	(0.006)	(0.001)
State dummy	0.065[a]	0.005[a]
	(0.019)	(0.002)
Foreign dummy	0.144[a]	-0.022[a]
	(0.020)	(0.002)
Export dummy	0.017[b]	0.001
	(0.007)	(0.001)
City-Sector Fixed effects	yes	yes
R-squared	0.45	0.48
Observations	112,171	112,171
Underidentification test	62.0[a]	62.4[a]
First-stage F test of excluded instruments	415[a]	428[a]
Overidentification Hansen J statistic	0.06	0.66
Chi-sq(1) (p-value)	0.81	0.42

Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the city level. [a], [b] and [c] indicate significance at the 1%, 5% and 10% confidence level. Exposed is a dummy that indicates that the average wage in the firm in 2003 is lower than the local minimum wage in 2005. Δ indicate variation between 2003 and 2005. All other right-hand side variables are measured in 2003. Instruments used in the IV procedure of Δ Ln Minimum wage 2003-05 × Exposed in columns (3) and (4) are the interactions of the local minimum wage in 2003 and the predicted minimum wage change based on the 40% rule (see text) with the exposed dummy. The underidentification test is based on the Kleibergen-Paap rk LM statistic, with [a] indicating that the p-value (Chi-sq(2)) is below 0.01 suggesting that underidentification is rejected. The F test of excluded instruments in the first stage equation is based on the Kleibergen-Paap Wald rk F statistic, with [a] indicating that the p-value is below 0.01 suggesting that the instruments are not weak. The F-statistic on the excluded instruments is largely above 10, the informal threshold suggested by Staiger and Stock (1997) to assess the validity of instruments. The Hansen J statistic is an overidentification test of all instruments, a Chi-sq(1) (p-value) above 0.10 suggests that the model is overidentified and the instruments are exogenous.

Table 14: Alternative explanations: City-level unemployment and share of migrants

Explained variable	Δ City-level outcome					
Outcome variable	Unemployment rate 2003-05		Ratio migrants/residents 2000-05			
			total population		working age population	
Estimator	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Real Minimum wage 2003-05	-0.003	0.005	0.069	-0.019	0.105	-0.018
	(0.002)	(0.003)	(0.065)	(0.066)	(0.090)	(0.086)
Ln Employment	-0.001	-0.001	0.041^c	0.042^c	0.055^c	0.057^c
	(0.001)	(0.001)	(0.024)	(0.024)	(0.029)	(0.029)
Unemployment rate	-0.709^a	-0.707^a				
	(0.167)	(0.168)				
Ratio of migrants (total)			-0.541^a	-0.543^a		
			(0.186)	(0.184)		
Ratio of migrants (working age)					-0.415^b	-0.417^b
					(0.185)	(0.183)
Ln GDP per capita	0.003^a	0.003^a	0.090^a	0.089^a	0.058	0.057
	(0.001)	(0.001)	(0.033)	(0.032)	(0.041)	(0.041)
Ln Population	-0.001	0.001	0.026	0.023	0.021	0.017
	(0.001)	(0.001)	(0.024)	(0.023)	(0.030)	(0.029)
FDI over GDP	-0.001	0.001	0.094^b	0.090^b	0.124^b	0.118^b
	(0.001)	(0.001)	(0.046)	(0.045)	(0.054)	(0.053)
Ratio of univ. students over population	0.001^c	0.001^c	-0.001^b	-0.001^a	-0.001^b	-0.001^b
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
R-squared	0.70	0.69	0.53	0.53	0.39	0.39
Observations	261		261			
Underidentification test		41.9^a		42.1^a		42.2^a
First-stage F test of excluded instruments		86.3^a		80.4^a		80.4^a
Overid. Hansen J stat		0.86		0.88		0.03
Chi-sq(1) (p-value)		0.36		0.35		0.87

Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the city level. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level. Δ indicate variation between 2003 and 2005. All other right-hand side variables are measured in 2003. Instruments used in the IV procedure of Δ Ln Minimum wage 2003-05 in columns (2), (4) and (6) are the local minimum wage in 2003 and the predicted minimum wage change based on the 40% rule (see text). The underidentification test is based on the Kleibergen-Paap rk LM statistic, with ^{a} indicating that the p-value (Chi-sq(2)) is below 0.01 suggesting that underidentification is rejected. The F test of excluded instruments in the first stage equation is based on the Kleibergen-Paap Wald rk F statistic, with ^{a} indicating that the p-value is below 0.01 suggesting that the instruments are not weak. The F-statistic on the excluded instruments is largely above 10, the informal threshold suggested by Staiger and Stock (1997) to assess the validity of instruments. The Hansen J statistic is an overidentification test of all instruments, a Chi-sq(1) (p-value) above 0.10 suggests that the model is overidentified and the instruments are exogenous.

Table 15: Differential effect for low-skill and high-skill intensive city-sectors

Explained variable	Δ Firm outcome (2003-05)							
Estimator	IV estimator							
Outcome	Survival		Ln average wage		Ln Employment		Ln labor productivity	
	Low	High	Low	High	Low	High	Low	High
Δ Ln Real Minimum wage 2003-05 × Exposed	-0.221[a]	-0.200[a]	0.493[a]	0.195[b]	-0.076	-0.016	0.461[a]	0.278[a]
	(0.038)	(0.036)	(0.141)	(0.091)	(0.062)	(0.049)	(0.074)	(0.061)
Ln Firm employment	0.075[a]	0.087[a]	0.062[a]	0.039[a]	-0.117[a]	-0.124[a]	0.038[a]	0.022[a]
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)	(0.007)	(0.006)
Ln Firm wage	0.022[a]	0.016[a]	-0.728[a]	-0.806[a]	0.091[a]	0.103[a]	-0.048[a]	-0.075[a]
	(0.004)	(0.005)	(0.036)	(0.024)	(0.008)	(0.010)	(0.015)	(0.011)
Ln Firm labor productivity	0.053[a]	0.055[a]	0.093[a]	0.089[a]	0.120[a]	0.114[a]	-0.284[a]	-0.292[a]
	(0.003)	(0.004)	(0.006)	(0.007)	(0.006)	(0.007)	(0.012)	(0.014)
Export dummy	0.022[a]	0.033[a]	0.016[b]	0.016[c]	0.056[a]	0.039[a]	-0.007	-0.032[a]
	(0.007)	(0.006)	(0.007)	(0.009)	(0.009)	(0.008)	(0.009)	(0.009)
State dummy	-0.094[a]	-0.112[a]	0.076[a]	0.020	-0.055[a]	-0.075[a]	-0.182[a]	-0.211[a]
	(0.021)	(0.016)	(0.020)	(0.021)	(0.011)	(0.021)	(0.027)	(0.033)
Foreign dummy	0.027[a]	0.027[a]	0.191[a]	0.149[a]	0.006	0.021[b]	0.076[a]	0.031[a]
	(0.008)	(0.007)	(0.025)	(0.017)	(0.009)	(0.010)	(0.016)	(0.011)
City-Sector Fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
R-squared	0.06	0.06	0.45	0.49	0.13	0.12	0.14	0.15
Observations	76,573	73,605	57,474	54,200	57,474	54,200	57,474	54,200
Underidentification test	56.2[a]	59.3[a]	55.8[a]	57.8[a]	55.8[a]	57.8[a]	55.8[a]	57.8[a]
First-stage F test of excluded instruments	312[a]	520[a]	318[a]	528[a]	318[a]	528[a]	318[a]	528[a]
Overidentification Hansen J statistic	0.80	0.35	0.11	0.01	1.05	0.92	1.21	1.08
Chi-sq(1) (p-value)	0.37	0.56	0.74	0.96	0.31	0.34	0.27	0.30

Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the city level. [a], [b] and [c] indicate significance at the 1%, 5% and 10% confidence level. Exposed is a dummy that indicates that the average wage in the firm in 2003 is lower than the local minimum wage in 2005. Δ indicate variation between 2003 and 2005. All other right-hand side variables are measured in 2003. Instruments used in the IV procedure of Δ Ln Minimum wage 2003-05 × Exposed are the interactions of the local minimum wage in 2003 and the predicted minimum wage change based on the 40% rule (see text) with the exposed dummy. The underidentification test is based on the Kleibergen-Paap rk LM statistic, with [a] indicating that the p-value (Chi-sq(2)) is below 0.01 suggesting that underidentification is rejected. The F test of excluded instruments in the first stage equation is based on the Kleibergen-Paap Wald rk F statistic, with [a] indicating that the p-value is below 0.01 suggesting that the instruments are not weak. The F-statistic on the excluded instruments is largely above 10, the informal threshold suggested by Staiger and Stock (1997) to assess the validity of instruments. The Hansen J statistic is an overidentification test of all instruments, a Chi-sq(1) (p-value) above 0.10 suggests that the model is overidentified and the instruments are exogenous.

Table 16: Differential effect depending on firm-level exposure intensity

Explained variable	Δ Firm outcome (2003-05)				
Estimator	IV estimator				
Outcome	Survival (1)	Ln average wage (2)	Ln Employment (3)	Ln labor productivity (4)	Profit over output (5)
Δ Ln Real Minimum wage 2003-05 $\times$ "above median" Exposed	-0.375^a	1.179^a	0.037	0.706^a	0.273
	(0.048)	(0.203)	(0.063)	(0.095)	(0.235)
Δ Ln Real Minimum wage 2003-05 $\times$ "below median" Exposed	-0.140^a	0.068	-0.081^b	0.269^a	0.107
	(0.029)	(0.076)	(0.039)	(0.053)	(0.098)
Ln Firm employment	0.081^a	0.051^a	-0.120^a	0.031^a	0.001
	(0.003)	(0.003)	(0.004)	(0.006)	(0.003)
Ln Firm wage	0.010^b	-0.716^a	0.102^a	-0.041^a	0.025
	(0.004)	(0.033)	(0.007)	(0.013)	(0.026)
Ln Firm labor productivity	0.053^a	0.088^a	0.117^a	-0.288^a	0.011
	(0.003)	(0.005)	(0.005)	(0.011)	(0.010)
Export dummy	0.028^a	0.016^b	0.047^a	-0.020^a	0.021
	(0.005)	(0.007)	(0.006)	(0.007)	(0.017)
State dummy	-0.097^a	0.050^a	-0.061^a	-0.196^a	-0.268
	(0.018)	(0.018)	(0.011)	(0.025)	(0.200)
Foreign dummy	0.030^a	0.158^a	0.013^c	0.047^a	0.025
	(0.006)	(0.019)	(0.007)	(0.011)	(0.021)
City-Sector Fixed effects	yes	yes	yes	yes	yes
R-squared	0.06	0.47	0.12	0.14	0.01
Observations	152,226	112,171	112,171	112,171	112,171
Underidentification test	63.9^a	61.0^a	61.0^a	61.0^a	61.0^a
First-stage F test of excluded instruments	189^a	192^a	192^a	192^a	192^a
Overidentification Hansen J statistic	2.05	0.43	1.54	2.14	4.40
Chi-sq(1) (p-value)	0.36	0.79	0.46	0.34	0.11

.4 Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the city level. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level. Exposed is a dummy that indicates that the average wage in the firm in 2003 is lower than the local minimum wage in 2005. Δ indicate variation between 2003 and 2005. All other right-hand side variables are measured in 2003. Instruments used in the IV procedure of Δ Ln Minimum wage 2003-05 $\times$ Exposed are the interactions of the local minimum wage in 2003 and the predicted minimum wage change based on the 40% rule (see text) with the exposed dummy. The underidentification test is based on the Kleibergen-Paap rk LM statistic, with ^{a} indicating that the p-value (Chi-sq(2)) is below 0.01 suggesting that underidentification is rejected. The F test of excluded instruments in the first stage equation is based on the Kleibergen-Paap Wald rk F statistic, with ^{a} indicating that the p-value is below 0.01 suggesting that the instruments are not weak. The F-statistic on the excluded instruments is largely above 10, the informal threshold suggested by Staiger and Stock (1997) to assess the validity of instruments. The Hansen J statistic is an overidentification test of all instruments, a Chi-sq(1) (p-value) above 0.10 suggests that the model is overidentified and the instruments are exogenous.

Table 17: Differential effect depending on firm ownership

Explained variable	Δ Firm outcome (2003-05)				
Estimator	IV estimator				
Outcome	Survival (1)	Ln average wage (2)	Ln Employment (3)	Ln labor productivity (4)	Profit over output (5)
Δ Ln Real Minimum wage 2003-05 × Exposed	-0.205^{a}	0.380^{a}	-0.080^{b}	0.414^{a}	0.155
	(0.034)	(0.104)	(0.039)	(0.060)	(0.151)
Δ Ln Minimum wage 2003-05 × Foreign	-0.091	-0.029	-0.069	-0.125	-0.326^{c}
	(0.074)	(0.258)	(0.095)	(0.166)	(0.197)
Δ Ln Minimum wage 2003-05 × Exposed × Foreign	-0.049	-0.180	0.211^{b}	-0.261^{b}	-0.054
	(0.043)	(0.136)	(0.088)	(0.128)	(0.117)
Ln Firm employment	0.081^{a}	0.052^{a}	-0.120^{a}	0.031^{a}	0.001
	(0.003)	(0.004)	(0.004)	(0.006)	(0.004)
Ln Firm average wage	0.019^{a}	-0.763^{a}	0.098^{a}	-0.060^{a}	0.018
	(0.004)	(0.031)	(0.007)	(0.011)	(0.020)
Ln Firm labor productivity	0.053^{a}	0.092^{a}	0.117^{a}	-0.286^{a}	0.012
	(0.003)	(0.005)	(0.005)	(0.012)	(0.010)
Export dummy	0.028^{a}	0.017^{b}	0.047^{a}	-0.020^{a}	0.021
	(0.005)	(0.007)	(0.006)	(0.007)	(0.017)
State dummy	-0.098^{a}	0.062^{a}	-0.060^{a}	-0.191^{a}	-0.266
	(0.018)	(0.019)	(0.011)	(0.025)	(0.199)
Foreign dummy	0.047^{a}	0.177^{a}	0.022	0.081^{b}	0.090
	(0.015)	(0.065)	(0.021)	(0.039)	(0.061)
City-Sector Fixed effects	yes	yes	yes	yes	yes
R-squared	0.06	0.47	0.12	0.14	0.01
Observations	152,226	112,171	112,171	112,171	112,171
Underidentification test	65.5^{a}	65.9^{a}	65.9^{a}	65.9^{a}	65.9^{a}
First-stage F test of excluded instruments	202^{a}	203^{a}	203^{a}	203^{a}	203^{a}
Overidentification Hansen J statistic	3.95	5.23^{c}	2.06	1.79	6.35^{b}
Chi-sq(1) (p-value)	0.14	0.07	0.36	0.41	0.04

Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the city level. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level. Exposed is a dummy that indicates that the average wage in the firm in 2003 is lower than the local minimum wage in 2005. Δ indicate variation between 2003 and 2005. All other right-hand side variables are measured in 2003. Instruments used in the IV procedure of Δ Ln Minimum wage 2003-05 × Exposed are the interactions of the local minimum wage in 2003 and the predicted minimum wage change based on the 40% rule (see text) with the exposed dummy. The underidentification test is based on the Kleibergen-Paap rk LM statistic, with ^{a} indicating that the p-value (Chi-sq(2)) is below 0.01 suggesting that underidentification is rejected. The F test of excluded instruments in the first stage equation is based on the Kleibergen-Paap Wald rk F statistic, with ^{a} indicating that the p-value is below 0.01 suggesting that the instruments are not weak. The F-statistic on the excluded instruments is largely above 10, the informal threshold suggested by Staiger and Stock (1997) to assess the validity of instruments. The Hansen J statistic is an overidentification test of all instruments, a Chi-sq(1) (p-value) above 0.10 suggests that the model is overidentified and the instruments are exogenous.

Table 18: Minimum wage and components of city-level employment growth

Explained component	Δ Ln Employment city-level (2003-2005)				
Firms	all		exiting	surviving	entry
Estimator	OLS	IV	IV		
	(1)	(2)	(3)	(4)	(5)
Δ Real Minimum wage 2003-05	0.629^a	0.162	0.543^c	-0.051	0.656^c
	(0.157)	(0.209)	(0.328)	(0.084)	(0.366)
Ln Labor productivity	-0.193^c	-0.191^c	0.008	0.048	-0.342^b
	(0.098)	(0.100)	(0.115)	(0.033)	(0.154)
Ln Number of firms	-0.169	-0.162	1.055^a	0.032^b	0.378^a
	(0.105)	(0.106)	(0.066)	(0.015)	(0.072)
Ln Average size of firms	0.418	0.569	0.904^a	0.004	0.269^b
	(0.881)	(0.905)	(0.133)	(0.025)	(0.135)
Ln GDP per capita	0.337^a	0.326^a	-0.154^c	-0.028	0.543^a
	(0.074)	(0.074)	(0.084)	(0.023)	(0.114)
Ln Population	0.181^a	0.166^a	-0.040	-0.006	0.270^a
	(0.044)	(0.045)	(0.072)	(0.013)	(0.071)
FDI over GDP	0.087^c	0.068	-0.136^b	0.061^a	-0.011
	(0.046)	(0.047)	(0.063)	(0.022)	(0.083)
Share of Univ student in population urban	-0.0002^b	-0.0002^b	0.0002^c	-0.0002^a	-0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
R-squared	0.39	0.36	0.79	0.13	0.60
Observations	261		261	261	261
Underidentification test		44.2^a	40.0^a	40.0^a	40.0^a
First-stage F test		84.2^a	84.7^a	84.7^a	84.7^a
Overid. Hansen J stat		1.72	0.12	0.09	1.38
Chi-sq(1) (p-value)		0.19	0.74	0.76	0.24

Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the city level. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level. Δ indicate variation between 2003 and 2005. All other right-hand side variables are measured in 2003. Instruments used in the IV procedure of Δ Ln Minimum wage 2003-05 are the local minimum wage in 2003 and the predicted minimum wage change based on the 40% rule (see text). The underidentification test is based on the Kleibergen-Paap rk LM statistic, with ^{a} indicating that the p-value (Chi-sq(2)) is below 0.01 suggesting that underidentification is rejected. The F test of excluded instruments in the first stage equation is based on the Kleibergen-Paap Wald rk F statistic, with ^{a} indicating that the p-value is below 0.01 suggesting that the instruments are not weak. The F-statistic on the excluded instruments is largely above 10, the informal threshold suggested by Staiger and Stock (1997) to assess the validity of instruments. The Hansen J statistic is an overidentification test of all instruments, a Chi-sq(1) (p-value) above 0.10 suggests that the model is overidentified and the instruments are exogenous. For definitions of the various margins (from exiting, surviving and entry firms) refer to the text in Section 6.2.

Table 19: Minimum wage and components of city-level labor productivity growth

Estimator	IV						
Explained component	Total (1)	Within (2)	Between (3)	Covariance (4)	Net entry (5)	Entry (6)	Exit (7)
Δ Real Minimum wage 2003-05	0.356[b]	0.218[c]	-0.098	-0.063	0.299[b]	0.184	-0.116[c]
	(0.168)	(0.132)	(0.066)	(0.110)	(0.141)	(0.129)	(0.060)
Ln Labor productivity	-0.177[b]	-0.086	-0.067	0.097	-0.120	-0.191[a]	-0.071[b]
	(0.081)	(0.070)	(0.042)	(0.065)	(0.080)	(0.067)	(0.030)
Ln Employment	-0.030	-0.046	0.010	0.068[c]	-0.062[b]	-0.046	0.016[c]
	(0.043)	(0.038)	(0.019)	(0.035)	(0.028)	(0.029)	(0.009)
Ln GDP per capita	0.057	0.056	0.022	-0.083[c]	0.062	0.083[c]	0.021
	(0.058)	(0.051)	(0.027)	(0.044)	(0.048)	(0.045)	(0.016)
Ln Population	0.044	0.015	0.008	-0.034[c]	0.055[b]	0.041[c]	-0.014
	(0.032)	(0.025)	(0.011)	(0.019)	(0.024)	(0.022)	(0.009)
FDI over GDP	-0.047	-0.030	0.015	-0.004	-0.027	-0.012	0.015[c]
	(0.036)	(0.025)	(0.012)	(0.019)	(0.029)	(0.028)	(0.008)
Ratio of univ. students	0.0001[a]	0.001	0.001	-0.001	0.0001[a]	0.0001[a]	-0.0001[b]
over population	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
R-squared	0.07	0.03	0.10	0.09	0.13	0.13	0.14
Observations	261	261	261	261	261	261	261
Underidentification test	43.8[a]	43.8[a]	43.8[a]	43.8[a]	43.8[a]	43.8[a]	43.8[a]
First-stage F test	81.8[a]	81.8[a]	81.8[a]	81.8[a]	81.8[a]	81.8[a]	81.8[a]
Overid. Hansen J stat	0.26	1.02	0.01	0.01	1.65	2.32	0.12
Chi-sq(1) (p-value)	0.61	0.31	0.92	0.98	0.20	0.13	0.73

.2 Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the city level. [a], [b] and [c] indicate significance at the 1%, 5% and 10% confidence level. Δ indicate variation between 2003 and 2005. All other right-hand side variables are measured in 2003. Instruments used in the IV procedure of Δ Ln Minimum wage 2003-05 are the local minimum wage in 2003 and the predicted minimum wage change based on the 40% rule (see text). The underidentification test is based on the Kleibergen-Paap rk LM statistic, with [a] indicating that the p-value (Chi-sq(2)) is below 0.01 suggesting that underidentification is rejected. The F test of excluded instruments in the first stage equation is based on the Kleibergen-Paap Wald rk F statistic, with [a] indicating that the p-value is below 0.01 suggesting that the instruments are not weak. The F-statistic on the excluded instruments is largely above 10, the informal threshold suggested by Staiger and Stock (1997) to assess the validity of instruments. The Hansen J statistic is an overidentification test of all instruments, a Chi-sq(1) (p-value) above 0.10 suggests that the model is overidentified and the instruments are exogenous. For definitions of the various margins (within, between, covariance, entry, exit) refer to the text in Section 7.2.

Appendix

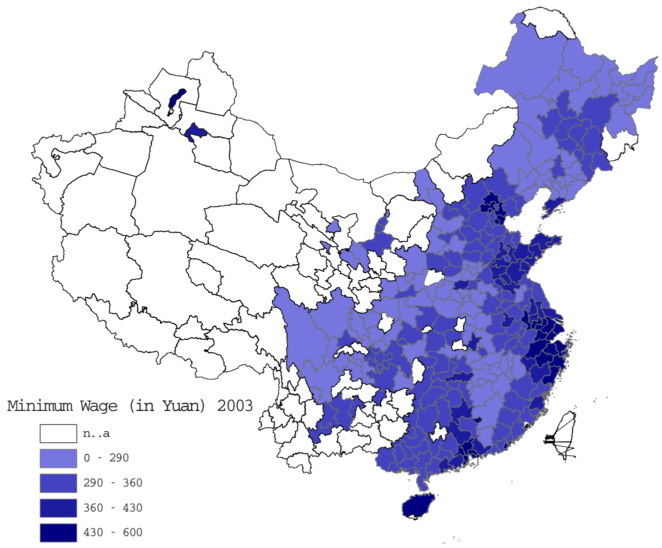

Figure 1: Monthly minimum wage in 2003 (yuan)

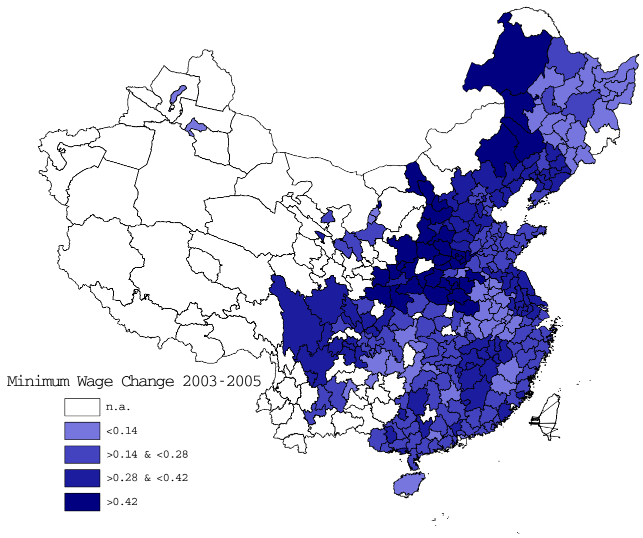

Figure 2: Δ Monthly minimum wage 2003-05

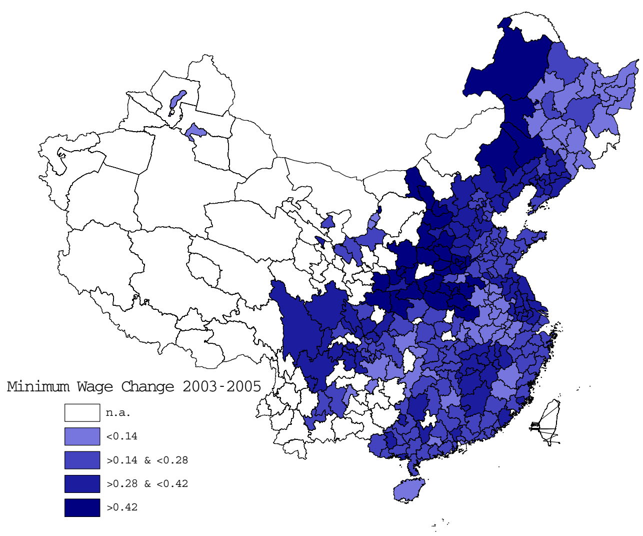

Figure 3: Δ Monthly real minimum wage 2003-05