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Impact of Minimum Wages on Employment and Wage Distribution in Vietnam: Gender and Age Perspectives

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Since 2008, minimum wages in Vietnam have grown at about 15 percent annually. This growth has been higher than productivity growth. Using data from Vietnam Labour Force Surveys and Household Living Standard Surveys 2010 to 2014, this paper investigates the impacts of minimum wages on two interrelated issues: (1) employment profiles of the whole population and gender and age subgroups, and (2) wages distribution in general and within these subgroups. The results imply that minimum wages do not have significant impacts on total employment of the whole population or subgroups. This result is somewhat different from those reported in previous studies for Vietnam. The difference is attributed to the current study's inclusion of trends. Similarly to the work of Hansen, Rand and Torm (2015), the results indicate that minimum wages positively affect wage distribution in the formal sector. However, we find that the effect does not stop at the median as those scholars found but also affects higher percentiles. The effect is stronger for young workers than for older workers. The model does not work well for male workers or wage earners in the informal sector.

3.1 Introduction

As part of economic reforms since Doi Moi (1986), the minimum wage was introduced in Vietnam in the early 1990s. According to the 2012 Labour Code, the minimum wage is "the lowest rate paid to workers for performing the simplest work in normal working conditions, and that has to secure their and their families' minimal living needs".

Since their introduction, minimum wage schemes have gone through a number of critical adjustments. Before 2008, the minimum wage for both state and non-state domestic sectors was mainly known as the "basic salary". In 2008, the minimum wage for non-state domestic sectors was separated from the "basic salary" of the state sector and acted truly as a minimum wage. In the following years, nominal minimum wages increased drastically, at a rate of more than 15 percent annually. The increases have been higher than in other countries in the region (Carpio and Pabon 2014) and higher than increases in labour productivity, making minimum wages in Vietnam higher than in a number of countries (World Bank 2015).

In addition, Oudin et al. (2013) report that expansion of employment in foreign direct investment (FDI) and domestic private enterprises has slowed since 2010. Specifically, the proportion of employment in FDI enterprises decreased by 0.25 percent in 2010–12, compared with an increase of 1.46 percent in 2007–09. Although the proportion of employment in domestic private enterprises still increased by 0.91 percent in 2010–12, it was significantly lower than the increase of 1.46 percent in 2007–09. This raises the question of whether increases in minimum wages played a role in employment slowdown in these types of firms. This question is important because the relative expansion of employment in the enterprise sector is an indicator of modernisation of Vietnam's labour market.

Initial works on the topic for Vietnam (Nguyen 2010; Carpio and Pabon 2014; Nguyen 2014; Hansen, Rand and Torm 2015) indicate a small but negative effect on employment and a positive impact on wage distribution. However, these studies investigate only the whole labour market or a specific group of workers receiving less than the minimum wage in foreign-owned, state-owned and domestically owned private enterprises (Nguyen 2010). Meanwhile, the effect of gender and age differences has not been investigated. Furthermore, employment impact assessment studies (Nguyen 2010; Carpio and Pabon 2014; Nguyen 2014) mainly cover periods before 2010 and do not capture the unification of minimum wages across enterprise types (foreign versus domestic private) in 2012 and the slowing of employment expansion.

Towards filling these gaps, this paper investigates the effects of minimum wages on wage distribution and total employment in general and the movement

of employees between different types of employment in particular, with a focus on gender and age groups. The results not only confirm the impact, if any, of minimum wage policies in the new context but also contribute to the debate about the impact of minimum wages on employment and income distribution in two ways. First, the findings enrich empirical evidence on minimum wages in a developing country, about which there is scant information in the literature. Second, they provide detailed evidence of impacts on different groups that may be neutralised when the whole population is investigated.

The results show that increases in the minimum wage have not had significant impacts on total employment or on total employment in the formal sector, for the whole labour market in general and for subgroups in particular. This result is at variance with previous studies on Vietnam which found negative impacts of the minimum wage. Our different specifications reveal that the difference between the result of this study and previous studies is attributable to the inclusion of trends in the empirical models. Without trends in the empirical models, the results imply that there are negative effects of minimum wage on total employment as well as employment in the formal sector.

The study confirms that the minimum wage has a positive effect on wage distribution in the formal sector. Put differently, an increase in the minimum wage narrows the gaps between the lower percentiles and the 80th one. The narrowing effects are larger for percentiles on the left of the wage distribution. The difference between the result of our study and that of Hansen, Rand and Torm (2015) is that the effects do not stop at the median as reported in the latter but also affect higher percentiles. The difference is attributable to the current study correcting the potential for endogeneity bias.

The rest of the paper is organised as follows: Section 2 presents empirical evidence from the literature, Section 3 looks at the context of minimum wages in Vietnam, Section 4 presents sources of data, Section 5 presents empirical models for investigating the impact of minimum wages, Section 6 discusses the empirical results and Section 7 concludes with policy implications.

3.2 Literature review

3.2.1 Impact of minimum wages on employment

Theoretically, different models predict different effects of minimum wages on total employment. In a competitive labour market, if the binding minimum wage is higher than the clearance wage, unemployment will increase. Total employment decreases as a consequence. However, under the monopsony model, employment possibly increases if a binding minimum wage is imposed (Brown 1999).

Empirical evidence of the impact of minimum wages on employment in the US, the most intensively studied economy, has not reached a consensus. A frequently cited paper of Card and Krueger (1994) reports no negative effect on employment in the fast-food industry in New Jersey and Pennsylvania. No dis-employment impact was found by Addison, Blackburn and Cotti (2009) for low-wage retail trade subsectors in the US in 1990–2005. However, Neumark and Wascher (2007) argue that results for specific industries may not hold true for the economy as a whole. A review by Neumark, Salas and Wascher (2014) finds a negative employment elasticity of the minimum wage at 0.15 for teenage workers in the US.

The results are also somewhat diverse across developing countries. Maloney and Mendez (2004) find a significant dis-employment effect of minimum wages in Colombia. Lemos (2007) reports no impacts of minimum wages on employment for 1982–2004 in Brazil. By contrast, Montenegro and Pagés (2004) find a positive impact of minimum wages on employment in Chile. In a careful review of studies for developing countries, Betcherman (2015) concludes that the effect of minimum wages on employment is generally small.

3.2.2 Empirical evidence for impact of minimum wages on wages and income

Empirical evidence for impacts of minimum wages on income in general and income distribution in particular is more concentrated. Lee (1999) studies the impacts of minimum wages on wage distribution in the US from 1979 to 1989 and finds that an increase in inequality at the low end of the distribution could be attributed to deterioration of minimum wages, especially for women. He also shows that wage differences across gender, race and education groups were modestly affected by changes in real minimum wages.

Maloney and Menez (2004) report that, in Columbia, increases in minimum wages had a significant effect on wages, especially for workers whose incomes were initially close to the minimum wage. Lemos (2007) documents a compression of the wage distribution as a consequence of minimum wages in Brazil. Bosch and Manacorda (2010) attribute an increase in inequality in Mexico in 1989–2001 to the deteriorating minimum wage.

For Asian countries, Lin and Yun (2016) study the impacts of changes in minimum wages in China in 2002–09 using the model developed by Lee (1999). They find that increases in minimum wages had positive effects on income distribution, particularly in reducing the gap between the median and bottom deciles. Hohberg and Jay (2015) find that minimum wages have positive effects on wages in the formal sector in Indonesia, while wages in the informal sector are not affected. The review

of Betcherman (2015) finds wage compression in the covered sectors in developing countries, but disadvantaged subgroups in the labour market may be excluded from the benefits.

3.2.3 Initial evidence from Vietnam

Initial studies for Vietnam report a consistent effect of minimum wages on employment. They find negative though modest effects on employment for the whole labour market or some specific groups.

Nguyen (2010) uses data from the Vietnam Household Living Standard Surveys 2004 and 2006 to study the impacts of minimum wage increases on employment, wages and expenditures of workers in the formal sector earning below the minimum wage. The findings show that the increase in the minimum wage between 2004 and 2006 reduced employment in the formal sector where compensation was initially below the minimum wage, but had no significant effect on the wages and expenditures of formal sector workers. Using data from Enterprise Censuses 2008–10, Nguyen (2014) investigates the effects of increases in minimum wages on enterprises' labour and fixed assets. He finds that increases reduce employment: a 1 percent increase in real minimum wages results in a 0.1 percent decrease in firms' employment. A counterintuitive result is that male workers and those without social insurance face a higher probability of a reduction in wages, although the decrease in male workers' wages is small, at 0.06 percent for a 1 percent increase in real minimum wages.

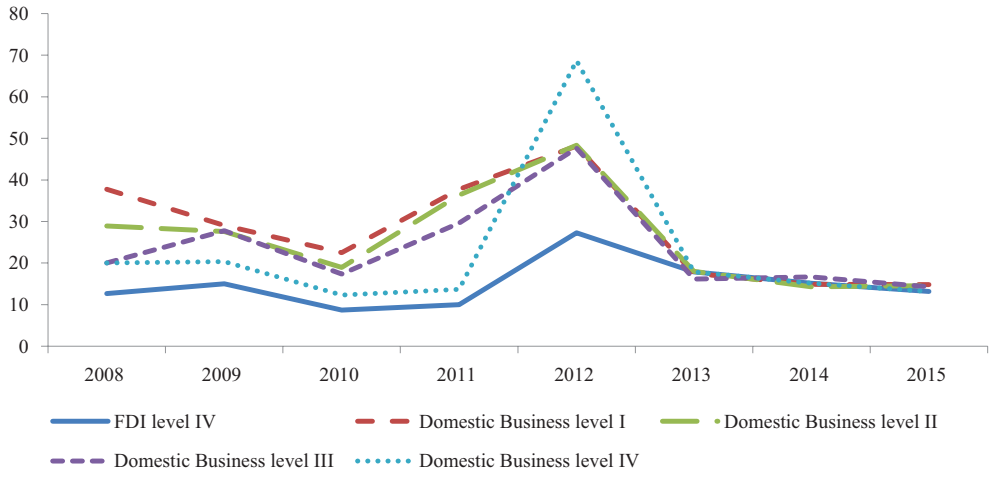
Carpio et al. (2013 cited in Carpio and Pabon 2014) also use data from Enterprise Censuses 2006–10 to investigate the impact of minimum wages on employment and wages. They find that increases in minimum wages have a negative impact on wage employment. Self-employment increases but absorbs only a part of the reduction in wage employment. Thus total employment declines as the minimum wage increases. In addition, the average wage of workers who retain their employment is positively affected by increases in minimum wages. Hansen, Rand and Torm (2015) use data from Vietnam Labour Force Surveys 2011–13 to investigate the association between minimum wages and hourly wages. They find that the relationship is positive for the formal sector. Furthermore, in the minimum wage increases compress wage distribution, bringing wages at the low end of the distribution closer to the median. Another finding is that the minimum wage setting has not affected income distribution in the informal sector, although the authors indicate that more representative data is needed to reach a proper conclusion about this.

3.3 The minimum wage in Vietnam

Minimum wages in Vietnam for different sectors have been introduced at different times. The first minimum wage scheme was introduced for the FDI sector in 1992, with two levels for differently developed regions. The first region included Hanoi and Ho Chi Minh City, and the second region was other provinces and cities. One year later, a minimum wage for those receiving payments from the state budget was promulgated, but it was not a minimum wage in the normal sense of the term. For civil servants and people receiving salaries and benefits from the state, there was a "basic salary", plus a system of multiples depending on their position, qualifications and seniority. A minimum wage for both state-owned and domestically owned private enterprises in all industries, which was the same as the "basic salary" for the state sector, was introduced under Decree No. 10/2000/ND-CP dated 27 March 2000. Since 1 October 2004, under Decree No. 203/2004/ND-CP dated 14 December 2004, the minimum wage for the domestic sector has been extended to cover all employees, including those working in cooperatives and household businesses.

There was another significant adjustment in 2008. The minimum wage for the domestic non-state sector was separated from the basic salary for the state sector and differentiated across locations based on level of development, the same as for the FDI sector. Within locations, the minimum wages for FDI firms were still significantly higher than for domestic non-state firms. This created three separate minimum wage schemes: for FDI sector, domestic non-state sector, and the basic salary for the state sector.

Figure 3.1: Growth rates of nominal minimum wages (percent), 2008–14



Source: Authors' calculations from minimum wages stipulated in government documents

In subsequent years, minimum wages increased rapidly, with different growth rates for the FDI sector and the domestic non-state sector (Figure 3.1). The gap between the two shrank because of higher growth rates in the latter. Higher increases in minimum wages for the domestic non-state sector in 2011 resulted in the unification of minimum wages across FDI and domestic non-state sectors from October 2011. The unification of minimum wages was induced by Vietnam's commitment to non-discrimination between domestically produced and imported goods and services in its domestic market on its accession to the World Trade Organization in 2007. However, the system of four minimum wage levels across locations, based on development, has been kept.

Since 2011, minimum wages for enterprises have increased about 15 percent annually. In 2015, the monthly minimum wage ranged from VND2,150,000 (USD100) in the fourth region to VND3,100,000 (USD144) in the first region. The increase in minimum wages has been significantly faster than the increase in labour productivity for recent years (World Bank 2015). To recap, Vietnam has long applied different minimum wages for different localities based on their stage of development. The number of levels for the FDI sector was extended from the initial two to three in 1996. The three levels were split into four in 2009. Districts are the primary level of administration for minimum wages, meaning that in one province there can be more than one minimum wage level.

3.4 Data

In this section, we describe the sources of primary data for empirical estimation, the calculation and the estimation of variables for empirical models.

The data used in this paper come from two survey series: the Vietnam Labour Force Survey (LFS) and the Vietnam Household Living Standard Survey (VHLSS), both conducted by the General Statistics Office. As individual panel data can be constructed from the VHLSS, it is used for investigating transition across types of employment. The large sample sizes of the LFS allow us to aggregate employment for investigating total employment effects and to estimate the wage percentiles for groups of districts within provinces for studying effects on wage distribution. The LFS is conducted monthly, and the sampling frame is drawn from the 2009 population census. Large sample sizes of more than 500,000 observations a year mean that the surveys are representative at the provincial level. The LFS collects information on education, employment status, wages and several demographic factors.

We restrict our sample to 2011–14 because we cannot retrieve district identification within provinces before 2011. Meanwhile, increases in minimum wages since 2012 have been relatively stable; put differently, raising the minimum wage has been a regular policy. In that context, actors in the economy

might incorporate predicted changes in minimum wages into their decisions, or regard minimum wage changes as endogenous. Therefore, if we include a long period after 2012, those endogenous behaviours may make increases in minimum wages no longer exogenous. Hansen, Rand and Torm (2015) restrict their study to 2011–2013 to capture only the "shock" increases in 2012. We extend one more year to be able to include trends in the empirical models.

The VHLSS is conducted every two years and follows the standardised contents of the Living Standards Measurement Study (LSMS) of the World Bank. The VHLSS sampling frame for 2010–18 is the same as that used for Population Census 2009. With a sample size of 9,400 households and about 37,000 individuals, the VHLSS is representative of the whole country and its six regions, with further breakdowns possible for urban and rural areas. The survey provides rich demographic information on households, education and employment of individuals aged 6 and above for the 12 months before survey. This allows us to define employment status and other characteristics.

The VHLSS is designed as a rotation survey. Theoretically, we can construct a two-wave panel for half of the observations and a three-wave panel (2010-2012-2014) for a quarter of the observations in 2010. In reality, the three-wave-balanced panel consists of 6,328 individuals (x3 = 18,984 observations). With the VHLSS 2010 sampling frame of 37,012 individuals, the theoretical sample size of the three-wave-balanced panel is about 9,250 individuals. So, the attrition rate is about 31.6 percent.

The three-wave-unbalanced panel is a combination of the two-wave panels of 2010–12 and 2012–14. It includes observations of the three-wave-balanced panel and additional observations of individuals of the two-wave panels of 2010–12 and 2012–14. The sample includes 6,328 individuals of the three-wave balanced panel and 17,041 individuals of the two-wave panels; the total number of observations is 53,066. On a rough calculation, the theoretical number of observations for this three-wave-unbalanced panel is 64,417, and the attrition rate is 17.7 percent.

We prefer the three-wave-unbalanced panel as it has advantages over both the balanced panel and the pooled cross-sectional sample. Compared with the balanced panel, the unbalanced panel has the advantages of (1) a significantly larger sample, (2) a considerably lower attrition rate and (3) a sample that better reflects the whole labour market in the lower attrition rate and is less restrictive for groups of individuals. Fixed-effects models are still applicable.

Consequently, the total number of observations of the panel sample is 53,066, of which 18,984 are three-wave-panel and 34,082 are two-wave panel. However, the panel data needs to be cleaned because there are potential errors in that the information may not identify the same persons over time. Our cleaning procedure is relatively simple: persons with inconsistent information

on birth year or gender across rounds are dropped from the sample. Thus we exclude 2,697 observations. After restricting ages, and retaining only panel observations, our final sample comprises 38,360 observations.

3.5 Methodology

In this section, we discuss models for investigating the impact of minimum wages on total employment, movement across types of employment and wage distribution. Identification problems in model construction and strategies for overcoming them are then discussed.

3.5.1 Impact of minimum wages on total employment and employment status

One of the most frequent questions is how minimum wages affect total employment. Therefore, we first discuss the model for estimating effects on total employment. We employ an aggregate model of the effects of minimum wage increases on total employment of locations over years. This specification helps us to reduce partially the effects of individuals moving across neighbouring districts. Meanwhile, the inclusion of both total working-age population and proportion of immigrants in locations as explanatory variables partially captures the effects of demographic changes. We aggregate employment for each group of districts with the same minimum wage level within provinces and estimate this variable against the minimum wages applied for that group of districts and other employment characteristics of the group, such as average education, ethnic composition and proportion of immigrants.

Specifically, the number of employees, S_{djt}, of group of districts d of province j at time t are explained by the following function:

$$S_{djt} = \beta_0 + pop_{djt}\beta_1 + X_{djt}\beta_2 + MW_{djt}\beta_3 + \pi_{dj} + \tau_{dj} + u_{idjt} \quad (1)$$

where pop_{djt} and X_{djt} are the number of working-age people and other characteristics of groups of district d in province j at time t; MW_{djt} is the minimum wage applied for the group of districts at time t; and π_{dj}, τ_{dj} are fixed effects of groups of districts and time-fixed effects, respectively. With this aggregation, we have 140 units over the country in one year. Given the availability of the Labour Force Survey (LFS) over years, we can calculate the data and construct panel data for the units. Consequently, fixed-effect panel models can be applied.

To capture the possibilities of difference in time trends across groups, interactions between years and groups are also included in the models. Therefore, the estimation model is:

$$S_{djt} = \beta_0 + pop_{djt}\beta_1 + X_{djt}\beta_2 + ln(MW_{djt})\beta_3 + \pi_{dj}\beta_4 + \tau_{dj}\beta_5 + \tau_{dj}\, dj\beta_6 + u_{ijt} \quad (2)$$

The second question deals with transition across types of employment for individuals who have jobs. Ideally, different types of employment based on institutional sectors such as private or state-owned enterprises, statutes at work and sectors should be investigated. For example, employment can be classified into four types: (1) wage work in formal FDI enterprises, domestic formal private enterprises and state-owned enterprises; (2) agricultural self-employment; (3) non-agricultural self-employment; and (4) wage work in household businesses. This grouping is relatively good at capturing the reallocation of labour across sectors in Vietnam. However, the short study period and the low frequency of employment changes cause difficulties in estimations, especially when we work in subgroups.[1] Therefore, we investigate only two types: (1) wage work in formal sectors and (2) other types of employment. This classification is still meaningful. First, it can answer whether minimum wages have negative effects on modernisation, that is, on the increase in the proportion of employment in formal sectors. Second, it can capture impacts on different sectors' levels of exposure to minimum wage regulation. Minimum wages in Vietnam apply to all types of salaried employment, including in household businesses and collectives, but degrees of exposure are significantly different. Required accounting systems and reports vary among sectors, leading to different perceptions and practices of regulatory compliance among sectors.[2] Therefore, there is a distinct difference in regulation between formal sectors and household businesses.

Specifically, type of employment k, of individual i in group of districts d within province j at time t is explained by the following function:

$$P_{ikdjt} = \beta_0 + X_{idjt}\beta_2 + MW_{djt}\beta_3 + \pi_{idj} + \tau_{dj} + u_{idjt} \quad (3)$$

where X_{ikdjt} is characteristics of individual i at group of districts d in province j at time t; MW_{djt} is the minimum wage applied for group of districts d in province j at time t; and π_{idj}, τ_{dj} are individual and time-fixed effects, respectively. Because we include the individual fixed effects in the models as discussed in more detail later, it is impossible to include any location fixed effects: u_{idjt} is unobservable time-variant variables.

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1 We tried to estimate the individual fixed-effects multinomial logit model using the method of Chamberlain (1980). However, estimation results could not be retrieved for a majority of specifications.

2 An example of difference in perception is that, if a business has fewer than 10 permanent employees, it does not have to register as an enterprise, and it is often misunderstood that it is also not necessary to pay social insurance for employees. However, the social insurance provisions regulate all types of employment. These facts result in weak compliance with regulations in household businesses, where fewer than 5 percent of wage workers have written contracts.

To capture possible differences in time trends across locations, interaction between time and location is included to form the estimation model as follows:

$$P_{ikdjt} = \beta_0 + X_{idjt}\beta_2 + ln(MW_{djt})\beta_3 + \pi_{idj}\beta_4 + \tau_{dj}\beta_6 + \theta_{ir}\tau_{dj}\beta_7 + u_{ijt} \quad (4)$$

where θ_{ir} is is location of individual i; and k takes 1 if the person is a wage earner in the formal sector and 0 for other types of employment. Consequently, a logit model is suitable for estimation. Given the availability of panel data for individuals as discussed in Section 4, the individual fixed-effects model is applicable. It is standard to estimate the fixed-effects logit model as conditional.

Several studies on the same topic include some economic environmental variables in (2). For example, Hohberg and Lay (2015) include provinces' GDP as a control for differences in economic conditions across locations; Gindling and Terrell (2007) include industry value added to control for changes in demand overtime. However, because our sample includes people who did not work in previous periods, working environment variables are impossible. Meanwhile, effects of locational economic conditions are partially captured by the trends.

3.5.2 Impact of minimum wages on distribution

To answer the second research question, we employ the model of Lee (1999); the explicit form is from Bosch and Manacorda (2010), Hansen, Rand and Torm (2015) and Autor, Manning and Smith (2016).

Intuitively, the functional form of (4) with the dependent variable as the wage of individuals can be applied to investigate impacts of minimum wages on income distribution by estimating impacts at different percentiles. However, observed wages are already affected by minimum wages. Therefore, the conditional quintiles (of the observed wages) do not reflect the true effects of minimum wages on wages at specific percentiles. Consequently, we need wages without the effects of minimum wages, but it is impossible to observe this. Therefore, we face a challenge of missing counterfactuals if we evaluate impacts of minimum wages on wage distribution (Hansen, Rand and Torm 2015). To solve this problem, Lee (1999) developed an approach to estimate the relative ratios across quintiles of the "latent" wage distribution, the distribution without effects of the minimum wage.

The underlying assumption of this approach is that the "latent" distribution of income does not vary in shape across time, location or type of ownership. The differences are the means and variances. Let us assume that w^q_{kdjt} is the q^{th} percentile of the latent log wage distribution of sector k of group of districts d in province j at time t, the distribution without the effect of minimum wages

w^q_{kdjt} is the corresponding percentile of the observed wage distribution of the same sector, group of districts in the province, and time.

It is assumed that there is a sufficiently high percentile p so that at that percentile and higher, the minimum wage does not affect the wage. If the minimum wage has the censoring effect that wages under the minimum are increased exactly to the minimum wage, we have a censoring model:

$$w^q_{kdjt} - w^p_{kdjt} = w^q_{kdjt} - w^p_{kdjt} \text{ if } w^q_{kdjt} \geq MW_{kdjt}$$
$$w^q_{kdjt} - w^p_{kdjt} = MW_{kdjt} - w^p_{kdjt} \text{ if } w^q_{kdjt} < MW_{kdjt}$$

where MW_{djt} is the minimum wage of group of districts d in province j at time t.

Removing the censoring assumption, $w^q_{kdjt} - w^p_{kdjt}$, is affected by both the minimum wage and the "latent" income differential, $w^q_{kdjt} - w^p_{kdjt}$. Let us define $MW_{djt} - w^p_{kdjt}$ as the "effective minimum wage" and allow for non-linear effects of the minimum wage. The quadratic term is included to capture dependencies of marginal effects on the level of effective minimum wages, following Lee (1999). Effects of the minimum wage on wage distribution can be estimated with:

$$w^q_{kdjt} - w^p_{kdjt} = \beta_{1,q}(MW_{sdjt} - w^p_{kdjt}) + \beta_{2,q}(MW_{sdjt} - w^p_{kdjt})^2 + \gamma_{k,q} + \delta_{dj,q} + \tau_{t,q} + (\gamma\delta)_{k,j} + (\gamma\tau)_{k,t} + (\delta\tau)_{j,t} + \beta_{x,q}X'_{kdjt} + \epsilon_{jkt,p} \quad (5)$$

where X'_{kdjt} are averages of the selected individual specific characteristics of sector k of group of districts d in province j at time t; $\delta_{dj,q}$ and $\tau_{t,q}$ are fixed effects of groups of districts and time trends, respectively; and terms in parentheses are interactions of these factors.

One empirical issue is to set the p^{th} percentile. Studies of the US (Lee 1999; Autor, Manning and Smith 2016) use the median. Studies using the same approach often set a higher percentile; for example, in a study by Leckcivilize (2015) of Thailand, p is the 60th percentile, and Bosch and Manacorda (2010) argue that the threshold should be the 70th percentile for Mexico. Therefore, in the current study, we shall examine a valid threshold in Vietnam.

3.5.3 Estimation strategies

For the models of total employment and wage distribution, one possible concern is the representativeness of figures for each group of districts. The LFS represents rural and urban areas within provinces separately. The classification of groups of districts for application of minimum wage levels is not identical to the urban and rural classification. Therefore, figures for each group of districts do not fully secure their representativeness. However, the maximum number of groups of districts within a province is three, which is not too low. Indeed, with 63 provinces, we have 126 representative areas.

Meanwhile, we have 140 groups of districts, which is modestly larger than the number of representative areas. Of course, the groups of districts are not identical to the urban and rural areas within provinces. Consequently, a number of the groups secure the representativeness and others do not. However, the modest difference between the number of groups and the number of representative areas implies that the under-representativeness of some groups of districts is not a serious problem.

We also filter the sample with certain criteria. First, labourers aged less than 15 or over 65 are excluded. Second, only labourers who work for more than 20 hours per week are retained. These selections avoid the effects of outliers, especially when we estimate hourly income. Too young or too old labourers as well as those who have worked for a short time may have specific incomes which are potentially different from that of a typical labourer. Within groups of districts, formal and informal sectors are estimated separately. The formal sector is defined as for movements across types of employment: state-owned, FDI and domestic private enterprises. The informal sector covers wage earners in non-farm household businesses. Unfortunately, the income of self-employed or family workers is not available. Therefore, we cannot investigate the effects of minimum wage on the income of this group of workers.

To estimate wage percentiles within sectors of groups of districts as defined above, we face some problems. First, changes in the classification of districts led to different minimum wages over time. We also employ the classification of the period 2012–2014, which was stable for 2011, to secure identical groups over time. Second, when we work with different sectors within a group of districts in a province (hereafter referred to as sectors), as well as further separation in terms of gender and age, the number of observations for percentile estimation is small. Consequently, we select a sample of sectors with 50 observations or more. Both number of observations and total wage workers of sectors excluded from estimation account for less than 1 percent of total observations or total wage workers.

Since 2011, the LFS has been conducted monthly in a rotation strategy. A quarterly sample represents the nation. Each household is surveyed in two consecutive quarters and then excluded from the sample. Therefore, each individual is theoretically surveyed twice within a year. However, there are a number of individuals whose identifiers indicate that they were surveyed twice, but some information, such as age or gender, is inconsistent between the two surveys. In addition, we keep only one observation per year for individuals surveyed twice. Therefore, we have to clean the data before analysis. The cleaning procedure as well as keeping one observation for those surveyed twice is presented in the Annex.

As noted, the models of employment status include measures of trends. Ideally, trends of groups of districts that have the same level of minimum wage within provinces are controlled for. However, these trends are possibly too heavy for the models, given that we already employ individual fixed-effect models. Therefore, trends of districts with the same levels of minimum wage within geographic regions[3] of the country are used when the trends of groups of districts within provinces are impossible.

The model of Lee (1999) may suffer from measurement errors because the observed wages are used to estimate percentiles for both the dependent variable and the effective minimum wage as an independent variable in (3). In addition, if there are shocks that affect both the pth percentile and differences between specific percentiles and the pth percentile, the ordinary least squares (OLS) estimation of (3) will be biased (Autor, Manning and Smith 2016). Therefore, the two-stage least square estimation with instrumental variables proposed by Autor, Manning and Smith (2016) is employed to correct for bias. Specifically, the real minimum wage is used as an instrumental variable for the effective minimum wage. The square term of the minimum wage and interaction between the minimum wage and average of the median of the wage distribution are used as instruments for the square term of the effective minimum wage.

3.6 Results and discussion

3.6.1 Proportion of workers receiving wages below minimum wages

Table 3.1 presents the proportion of wage workers earning below minimum wages (the binding ratio) across groups and years. In general, the binding ratio increased tremendously in the study period. The binding ratio of all non-farm wage earners increased almost threefold after four years, from 3.8 percent to 11.6 percent. This increase is observed for all years but unevenly. The breaking increase was in 2012, when the binding ratio doubled. This pattern is consistent with the pattern of increases in real minimum wages.

In 2014, the binding ratio was extremely high for female workers. Although it was already high in 2011, it increased drastically in the study period and reached more than 40 percent in 2014.

As expected, the binding ratio was higher for female wage earners than for males. The gender difference was widened in absolute terms but narrowed relatively. This result can be partially explained by an extremely low binding

[3] Vietnam changed the administrative regions in 2010, reducing the number from eight to six. However, in this study, we construct eight geographical regions by province. This classification better captures heterogeneity across areas.

ratio of male wage earners in 2011, so that a small absolute gap resulted in a large relative difference. It is interesting that the gap in the binding ratio between the two genders was mainly caused by the difference in the informal sector. The difference in the formal sector was consistently less than 2 percent in all years, but the gap in the informal sector increased from 14.7 percent in 2010 to 30.3 percent in 2014.

The gap between young and older wage earners changed only slightly, and the pattern was similar in both formal and informal sectors. Possibly, the higher education of new labour market entrants makes up for their lack of experience.

Table 3.1: Proportion of workers receiving wages below minimum wage (percent)

	2011			2012		
	All non-farm wage	Non-farm formal	Non-farm informal	All non-farm wage	Non-farm formal	Non-farm informal
Whole sample	3.78	1.36	6.94	7.87	3.13	14.15
Gender						
Female	6.82	1.82	17.56	12.52	3.75	31.36
Male	1.94	0.99	2.88	4.97	2.60	7.35
Age						
Older (30–65)	3.92	1.33	6.75	8.04	3.09	13.61
Young (15–29)	3.62	1.40	7.23	7.62	3.17	15.08
	2013			2014		
	All non-farm wage	Non-farm formal	Non-farm informal	All non-farm wage	Non-farm formal	Non-farm informal
Whole sample	10.55	4.24	18.61	11.60	5.06	20.55
Gender						
Female	16.60	5.14	40.94	16.89	5.83	42.14
Male	6.69	3.43	9.75	8.10	4.35	11.83
Age						
Older (30–65)	10.61	3.86	18.05	11.71	4.76	19.82
Young (15–29)	10.46	4.71	19.62	11.44	5.45	21.97

Source: Authors' calculations using data from LFS 2011, 2012, 2013 and 2014

3.6.2 Employment effects

3.6.2.1 Total employment

Empirical results of the fixed-effects model of minimum wages on total employment of the whole population and different subgroups are presented in Table 3.2. To capture the potential non-linear association between minimum wages and employment, we also estimate the model with the square term of the log of minimum wages. The results of two specifications, with and without trends, are presented, given that time-fixed effects are included in both specifications. Our preferential specifications are those with trends of the minimum wage regions within the geographic regions, with and without the square term of minimum wages, given in columns (3) and (4) of Table 3.2, respectively.

Table 3.2: Effects of minimum wage on employment

Dependent variable: number of full-time jobs of the whole population of groups of districts or their subpopulations by age and gender				
	(1)	(2)	(3)	(4)
Whole population (aged 15–65)				
Minimum Wage (log)	-0.112**	-0.809	-0.075	0.028
	(0.055)	(0.588)	(0.064)	(1.120)
Minimum Wage (log), square		0.051		-0.008
		(0.042)		(0.082)
Year effect				
2011			Base	
2012	0.026	0.020	-0.040	-0.039
	(0.022)	(0.022)	(0.033)	(0.034)
2013	0.032	0.021	-0.089*	-0.088*
	(0.028)	(0.028)	(0.048)	(0.050)
2014	0.033	0.017	-0.142**	-0.140**
	(0.032)	(0.033)	(0.065)	(0.068)
Trend	No	No	Yes	Yes
Prob > chi2	0.000	0.000	0.000	0.000
Pseudo R2	0.840	0.841	0.919	0.919
Observations	560	560	560	560
Number of groups of districts	140	140	140	140
Total effect of minimum wage at mean		-0.075		-0.080
Wald test statistics of the total effects equal zero		1.65		0.84

Female workers				
Minimum Wage (log)	-0.157**	-2.062***	-0.079	-1.023
	(0.067)	(0.684)	(0.086)	(1.483)
Minimum Wage (log), square		0.140***		0.069
		(0.049)		(0.109)
Year effect				
2011		Base		
2012	0.043	0.024	-0.014	-0.021
	(0.028)	(0.027)	(0.043)	(0.045)
2013	0.046	0.017	-0.043	-0.054
	(0.033)	(0.034)	(0.063)	(0.066)
2014	0.049	0.005	-0.073	-0.090
	(0.039)	(0.040)	(0.085)	(0.089)
Trend	No	No	Yes	Yes
Pseudo R2	0.779	0.783	0.881	0.882
Observations	560	560	560	560
Number of groups of districts	140	140	140	140
Total effect of minimum wage at mean		-0.056		-0.029
Wald test of the total effect equal zero		0.61		0.07
Male workers				
Minimum Wage (log)	-0.069	0.326	-0.058	0.551
	(0.053)	(0.591)	(0.063)	(1.102)
Minimum Wage (log), square		-0.029		-0.045
		(0.043)		(0.081)
Year effect				
2011		Base		
2010	0.005	0.009	-0.070**	-0.065**
	(0.022)	(0.022)	(0.031)	(0.033)
2012	0.008	0.014	-0.138***	-0.130***
	(0.027)	(0.028)	(0.046)	(0.048)
2014	0.005	0.014	-0.210***	-0.200***
	(0.031)	(0.033)	(0.063)	(0.066)
Trend	No	No	Yes	Yes
Pseudo R2	0.853	0.853	0.924	0.924
Observations	560	560	560	560
Number of groups of districts	140	140	140	140
Minimum Wage (log) + 2* Minimum Wage (log), square* (mean of Minimum Wage (log))		-0.090		-0.090
Wald test of the total effect equal zero		2.31		1.12

Young (aged 15–29) workers				
Minimum Wage (log)	-0.123	-1.468*	0.022	-3.802**
	(0.080)	(0.809)	(0.102)	(1.759)
Minimum Wage (log), square		0.098		0.281**
		(0.060)		(0.129)
Year effect				
2011		Base		
2010	0.023	0.012	-0.076	-0.108**
	(0.033)	(0.035)	(0.050)	(0.052)
2012	0.024	0.005	-0.134*	-0.184**
	(0.042)	(0.045)	(0.075)	(0.078)
2014	0.038	0.011	-0.173*	-0.247**
	(0.048)	(0.054)	(0.100)	(0.105)
Trend	No	No	Yes	Yes
Pseudo R2	0.872	0.873	0.931	0.933
Observations	560	560	560	560
Number of groups of districts	140	140	140	140
Total effect of minimum wage at mean		-0.056		0.215
Wald test of the total effect equal zero		0.40		2.55
Older (aged 30–65) workers				
Minimum Wage (log)	-0.062	-0.695	-0.062	1.203
	(0.054)	(0.566)	(0.067)	(1.162)
Minimum Wage (log), square		0.047		-0.093
		(0.041)		(0.085)
Year effect				
2011		Base		
2010	0.012	0.006	-0.024	-0.014
	(0.021)	(0.022)	(0.034)	(0.035)
2012	0.015	0.005	-0.061	-0.045
	(0.027)	(0.027)	(0.050)	(0.052)
2014	0.008	-0.007	-0.106	-0.083
	(0.031)	(0.032)	(0.067)	(0.070)
Trend	No	No	Yes	Yes
Prob > chi2	0.000	0.000		
Pseudo R2	0.841	0.841	0.913	0.913
Observations	560	560	560	560
Number of groups of districts	140	140	140	140
Total effect of minimum wage at mean		-.027		-.131
Wald test of the total effect equal zero		0.21		2.04

Panel fixed-effect model

Trend: trends of groups of district with the same level of minimum wage within provinces. 140 groups in total. Robust standard error in parenthesis

*** p<0.01, ** p<0.05, * p<0.1

Source: Authors' estimation using data from LFS, 2011, 2012, 2013 and 2014

In general, the coefficients of the association between the amount of employment and minimum wages are negative. However, only the coefficient in the specification without trends and the first order of minimum wages is significant at 5 percent. The change into insignificance of the coefficients in the specification with trends indicates the strong effect of trends in the study period. Therefore, these results imply that increases in minimum wages do not have an effect on total employment.

The situation of Vietnam's labour market in the period may be an underlying reason for the insignificant effect. First, the demographic trend meant the net increment of working-age population decreased significantly. Our calculations from LFSs are that the net increase of population aged 15–65 in 2011 was 942,000 people, then dropped to 640,000 in 2012, 312,000 in 2013 and 308,000 in 2014. This significant decline in the net increment of the working-age population in a short period would result in an increase of working opportunities for people already in the economy, which was accustomed to an average annual increase of almost 1 million in the working-age population. Therefore, if there was a factor that negatively affected employment in the economy, the demographic trend would mitigate its impact.

Second, compliance with labour regulations in Vietnam is quite weak in general. Our estimation from the 2012 Enterprise Census is that about 40 percent of enterprises do not contribute to social insurance although it is compulsory for any contracts of more than three months. Therefore, it is suggested that compliance with the minimum wage is also not strong. Furthermore, a majority of enterprises in our qualitative survey in Hanoi and Ho Chi Minh City reported that their workers' pay was already higher than the minimum wages. Minimum wages are used only for calculating social and health insurance and other wage-related contributions. Under current regulations, firms have to contribute about 22 percent of the compensation indicated in contracts for different types of insurance and contributions. Therefore, when the minimum wage increases, a majority of firms directly face only 22 percent of the increase.

Firms also have their own schedules of compensation increase, which may be coincident with increases in minimum wages. About 60 percent of firms in the qualitative survey reported no effects on their operation from changes in minimum wages. The remaining 40 percent said minimum wages affect them only modestly. The second and third factors mitigate the impact of minimum wages in firms. Meanwhile, the first situation neutralises any negative impact of increases in minimum wages on total employment.

The coefficients of minimum wages are also negative in the three subgroups of male, female and older workers. However, once again, all coefficients in the

specification with trends are statistically insignificant. The results indicate that minimum wages do not affect employment of these subgroups.

The coefficients are significant only in the specification including both the first and the second orders of minimum wages for the young worker subgroup. As the square term of minimum wages is included in regressions, it is not correct to conclude the direction of impact when signs of the estimated coefficients of the first and the second terms of the minimum wage are opposite. In this case, we may estimate the total effects at the mean of minimum wages by the formula: coefficient of the minimum wage +2*(coefficient of the square term)*(mean value of the minimum wage).

The positive result shown in Table 3.2 indicates a positive association between minimum wages and the employment of young workers on average. However, the Wald test for the total effect at the mean of minimum wages is statistically insignificant. Therefore, one question is at which levels of minimum wages is the total effect statistically significant? This question can be answered by estimation of minimum wage levels at which the statistic of the Wald test is higher than the critical value. With a 10 percent level of statistical significance, the total effect would be significant if the minimum wage was less than VND521,500 or higher than VND1,309,000 per month.

3.6.2.2 Transition across types of employment

For the transition among working people, we estimate the fixed-effect (conditional) logit model with and without trends. The estimation results for the whole working population and subgroups are given in Table 3.3.

The pseudo R2 of specifications with and without trends is remarkably different for models of the transition across types of employment. The pseudo R2 of the specification with trends is almost double that of the specification without trends for some cases. In addition, the inclusion of trends alters the statistical significance of estimated coefficients of the minimum wage in the models for all groups except female workers. This result confirms the importance of trends in Vietnam's labour market, as noted in the previous subsection on effects on total employment.

For the whole working population, the estimated coefficient of the minimum wage and its square term are negative but statistically insignificant in the specification with trends, although they are statistically significant in one specification without trends. This result indicates that increases in the minimum wage do not affect transition across types of employment.

Estimated coefficients for subgroups are negative in some cases, which implies a negative effect on the probability of moving to formal sectors. However, they are also statistically insignificant in the specification with

trends. Consequently, it is safe to conclude that minimum wage increases do not affect movements across sectors for the subgroups. Weak regulatory compliance in formal sectors is also a potential reason for the insignificant effect of the policy on transition across sectors.

Table 3.3: Effects of the minimum wage on probability of working in the formal sector

Dependent variable: probability of working in the formal sector of the whole working population or subpopulations by age and gender; it takes 1 if the person works in the formal sector and 0 otherwise

	(1)	(2)	(3)	(4)
Whole population (aged 15–65)				
Minimum Wage (log)	1.363	-27.748**	-0.596	-34.072
	(1.014)	(13.897)	(1.487)	(25.022)
Minimum Wage (log), square		2.012**		2.428
		(0.957)		(1.814)
Year effect				
2010	1.000	0.165	1.063	1.070
	(0.780)	(0.876)	(1.110)	(1.105)
2012	0.261	0.167	0.527	0.729
	(0.299)	(0.299)	(0.426)	(0.447)
2014		Base		
Trend	No	No	Yes	Yes
Prob > chi2	0.000	0.000	0.000	0.000
Pseudo R2	0.0436	0.0467	0.0698	0.0711
Observations	2055	2055	2055	2055
Total effect of minimum wage at mean		0.369		-0.137
Wald test of the total effect equal zero		0.11		0.01
Female workers				
Minimum Wage (log)	0.853	-6.937	0.775	-1.096
	(1.689)	(24.972)	(2.812)	(44.938)
Minimum Wage (log), square		0.537		0.135
		(1.704)		(3.235)
Year effect				
2010	0.165	-0.073	1.813	1.810
	(1.476)	(1.768)	(2.113)	(2.116)
2012	-0.117	-0.146	0.779	0.789
	(0.610)	(0.626)	(0.816)	(0.853)
2014		Base		
Trend	No	No	Yes	Yes
Prob > chi2	0.000	0.000	0.000	0.000
Pseudo R2	0.1218	0.1220	0.1791	0.1791
Observations	747	747	747	747
Total effect of minimum wage at mean		0.0570		0.795
Wald test of the total effect equal zero		0.08		0.08

Male workers				
Minimum Wage (log)	1.198	-42.020**	-1.716	-47.616
	(1.323)	(17.427)	(1.951)	(32.884)
Minimum Wage (log), square		2.985**		3.329
		(1.200)		(2.390)
Year effect				
2010	0.792	-0.578	-0.035	-0.059
	(1.105)	(1.275)	(1.542)	(1.569)
2012	0.237	0.031	0.167	0.425
	(0.435)	(0.464)	(0.604)	(0.642)
2014		Base		
Trend	No	No	Yes	Yes
Prob > chi2	0.0667	0.0198	0.0000	0.0000
Pseudo R2	0.0349	0.0413	0.0741	0.0763
Observations	1302	1302	1302	1302
Total effect of minimum wage at mean		-0.302		-1.094
Wald test of the total effect equal zero		0.04		0.28
Young (aged 15–65) workers				
Minimum Wage (log)	1.068	-47.405*	-2.550	-4.596
	(1.637)	(24.463)	(2.476)	(50.895)
Minimum Wage (log), square		3.351**		0.149
		(1.690)		(3.681)
Year effect				
2010	1.190	-0.256	1.888	1.896
	(1.438)	(1.596)	(2.332)	(2.330)
2012	0.461	0.273	1.301	1.318
	(0.592)	(0.582)	(0.996)	(1.067)
2014		Base		
Trend	No	No	Yes	Yes
	0.0013	0.0012	0.0000	0.0000
Pseudo R2	0.1148	0.1231	0.2169	0.2170
Observations	701	701	701	701
Total effect of minimum wage at mean		-0.574		-2.520
Wald test of the total effect equal zero		0.10		0.98

Older (aged 30–65) workers				
Minimum Wage (log)	2.691**	-22.769	1.223	-48.553
	(1.371)	(18.856)	(1.979)	(32.759)
Minimum Wage (log), square		1.763		3.615
		(1.303)		(2.383)
Year effect				
2010	1.962*	1.295	1.580	1.677
	(1.027)	(1.128)	(1.437)	(1.443)
2012	0.540	0.486	0.553	0.882
	(0.385)	(0.386)	(0.531)	(0.585)
2014		Base		
Trend	No	No	Yes	Yes
	0.4298	0.4342	0.0000	0.0000
Pseudo R2	0.0281	0.0304	0.0602	0.0630
Observations	1193	1193	1193	1193
Total effect of minimum wage at mean		1.872		1.968
Wald test of the total effect equal zero		1.56		0.91

The conditional logit model
Trend: groups of districts with the same level of the minimum wage within geographic regions. Robust standard error in parenthesis

*** p<0.01, ** p<0.05, * p<0.1

Source: Authors' estimation using data from VHLSS 2010, 2012, 2014

3.6.2.3 Robustness check

As noted above, the approach for investigating effects on total employment can also be used for employment in formal sectors. Under this approach, we can investigate the effects of minimum wages on total employment in formal sectors while controlling for total employment in groups of districts within provinces.

The estimation results with the fixed-effects panel model indicate that minimum wages do not significantly affect total employment in formal sectors, in specifications both with and without trends. Furthermore, none of the coefficients are significant in the results for subgroups. This supports the finding that minimum wages do not affect movements across types of employment, as discussed above.

We also estimate the effects of minimum wages on employment rates as a robustness check for the case of total employment. This specification is still influenced by demographic trends, as the reduction in the net increment of working-age population could promote working opportunities for existing workers. However, the inclusion of trends can partially capture the effects of demographic trends.

The estimation results are similar to that of total employment. Some coefficients are negative and statistically significant in the specification without trends. With the inclusion of trends, none of the estimated coefficients in the specifications are statistically significant, which confirms the results of insignificant effects of minimum wages on total employment.

3.6.3 Impacts on wage distribution

As the square term of the effective minimum wage is included in the estimation, we have to retrieve total effects by the formula introduced in Section 6.2: coefficient of the first order of the effective minimum wage +2*(coefficient of the second order term)*(mean value of the effective minimum wage). Then, the total effect is tested for being different from zero by the Wald test. If the total effect is positive, the increase in the minimum wage would compress the wage distribution to the threshold percentile and vice versa.

As noted in Section 5.3, we separate the sample into formal and informal sectors.[4] Unfortunately, tests for detecting the percentile at which the minimum wages does not affect it and higher percentiles fail in the informal sector of non-farm household businesses. Therefore, we cannot estimate the effect of minimum wages on wage distribution for the sector.

A key assumption of the model is the percentile above which minimum wages do not affect the "latent" wage distribution; we call it the threshold percentile. One implication of this assumption is that the effective minimum wage should not affect the gaps between the threshold percentile and higher ones. For studies in the US, the median is often used. Other studies for developing countries employ higher percentiles, as discussed above. Therefore, we first evaluate which percentile is valid in Vietnam.

To find the threshold percentile, we have to select the model specification among alternatives. The model with trends is our preference because it can capture time-variant local effects. In addition, the effective minimum wage is potentially endogenous. Therefore, endogeneity tests are conducted to see whether OLS estimations are valid. If the effective minimum wage and its square term are endogenous, estimation with instruments is employed to examine the validity of the threshold percentile.

Starting with the 60th percentile as the threshold, we investigate whether the effective minimum wage affects the gaps between the threshold percentile and higher ones. For the 70th and 80th percentiles, the results of the endogenous test indicate that the effective minimum wage and its square

[4] In the literature, the agricultural sector is not considered as informal. Therefore, we also exclude agriculture from the informal sector.

term are exogenous estimates for the gaps between these percentiles and the 60th percentile. The OLS results are therefore valid and the insignificant coefficients imply no effect of the effective minimum wage on the gaps. For the 90th percentile, the tests indicate that the effective minimum wage and its square are endogenous. However, the test for validity of the instrumental variables implies that the instruments are invalid. Therefore, we do not have information to learn whether the effective minimum wage impacts the gap between the 60th and 90th percentiles and cannot conclude whether the 60th percentile meets the condition of the model.

Moving to the 70th percentile, the effective minimum wage and its square are endogenous and the instruments are valid for estimation of the gaps for both 80th and 90th percentiles. The estimation results with the instruments imply that the effective minimum wage has a significant effect on the gaps between the 80th and 90th percentiles and the 70th. Therefore, the threshold of 70th percentile violates the condition.

However, the 80th percentile satisfies the condition. The effective minimum wage and its square term are endogenous and the instruments are valid. The estimation result indicates that the effect of the effective minimum wage and its square term on the gap between the 80th and 90th percentiles is insignificant, or the condition is met. Therefore, the 80th percentile is selected as the threshold.

The total effect of the effective minimum wage on the gaps between different percentiles and the 80th percentile, and statistics of relevant tests, are given in Table 3.5. For the whole population, there are two percentiles, the 20th and 30th, where the effective minimum wage and its square term are endogenous but the instruments are invalid. The remaining percentiles to the left of the 80th percentile do not suffer the endogeneity problem. OLS estimation is unbiased for these percentiles as a consequence.

All effects[5] are statistically significant at the 1 percent level, which indicates a strong association between the effective minimum wage and the wage distribution. The positive effect indicates a "compression" effect, or an increase in the effective minimum wage narrows the gaps between the lower percentiles and the 80th. Furthermore, the decreasing magnitudes of the effect for percentiles approaching the 80th imply that the effect is stronger for percentiles far from the threshold. This result is similar to that reported in Hansen, Rand and Torm (2015), that more "compression" effect is found for

[5] For the effects of the 20th and 30th percentiles, the instruments are invalid but there are positive associations between the effective minimum wage and the gaps between these percentiles and the 80th percentile in both OLS and instrument estimations. Therefore, we can tentatively argue that a positive association is also found for these percentiles.

low percentiles. As the thresholds are different, the median in Hansen, Rand and Torm and the 80th percentile in the current study, we cannot compare the magnitude of the effect. However, the trends are similar.

We now turn to the effect of minimum wages on the wage distribution of subgroups. The results with the threshold of 80th percentile and estimations with trends are reported in Table 3.4. We first evaluate whether the condition of no effect on higher percentiles is satisfied, that is, whether the effect of the effective minimum wage and its square term on the gap between the 80th and 90th percentiles is significant. Once again, depending on whether the effective minimum wage and its square term are endogenous, the OLS estimation or the estimation with the instruments is used for evaluation.

For age subgroups, the OLS estimation is unbiased, as the endogenous test implies there is no endogeneity. In addition, the effect on the gap between the 80th and 90th percentiles is statistically insignificant in both subgroups. Therefore, the 80th percentile satisfies the condition for these subgroups.

The effective minimum wage and its square term are endogenous in the estimation of the gap between the 80th and 90th percentiles for female workers, but the instruments are valid. Furthermore, the effect is insignificant in the estimation with instruments. This implies that the 80th percentile also meets the condition for female workers. The result of the endogenous test indicates that OLS estimation for the gap between the 80th and 90th percentiles is unbiased in the male subgroup. However, the OLS estimation result shows that the effective minimum wage is significantly associated with the gap. Consequently, the result for males is not reliable, and we cannot make comments on the result for the subgroup.

Table 3.4: Impacts of minimum wage on wage distribution in the formal sector

Dependent variable: distances between percentiles of wage (log) of the wage earners in the formal sectors of groups of districts or their subpopulations in terms of age and gender.

	OLS	Instrument variable	Durbin test statistics	Wu–Hausman test statistics	Statistics of test of over-identification
All wage earners (aged 15–65)					
p10-p80	0.7863***	0.4697	2.737	1.058	
p20-p80	0.6749***	1.5027*	8.733**	2.909*	2.760*
p30-p80	0.6875***	1.3397**	7.272**	2.522*	3.933**
p40-p80	0.5812***	1.0312**	3.303	1.078	
p50-p80	0.5294***	0.628**	0.247	0.087	
p60-p80	0.4202***	0.5349**	0.327	0.101	
p70-p80	0.2583***	-0.1418	4.361	1.375	
p90-p80	-0.1054	1.6936	16.899***	4.956***	0.041

Female workers					
p10-p80	0.8511***	0.8331***	2.084	0.620	
p20-p80	0.6861***	0.6499***	2.231	0.611	
p30-p80	0.6222***	0.6233***	0.018	0.005	
p40-p80	0.6414***	0.5779***	2.397	1.046	
p50-p80	0.5377***	0.5168***	0.961	0.349	
p60-p80	0.4335***	0.3143***	8.163**	1.522	
p70-p80	0.2345***	0.0953	15.036***	2.574*	0.132
p90-p80	0.0082	0.2485	7.791**	2.110	
Male workers					
p10-p80	0.6783***	-1.1392	5.200*	3.570**	0.172
p20-p80	0.7246***	-0.0609	2.417	0.610	
p30-p80	0.706***	-0.529	8.718**	2.580*	0.503
p40-p80	0.6467***	-0.6743	12.718***	3.962**	0.354
p50-p80	0.5562***	-1.1817	21.528***	7.255***	0.026
p60-p80	0.4193***	-0.7653	12.613***	2.588*	0.001
p70-p80	0.2208***	-0.4729	5.836*	0.872	
p90-p80	-0.3766***	-1.4706	2.721	0.898	
Young (15–29) workers					
p10-p80	0.8974***	0.4969**	2.832	0.658	
p20-p80	0.6376***	0.6652***	0.284	0.074	
p30-p80	0.5697***	0.6204***	4.068	0.818	
p40-p80	0.5521***	0.6401***	7.577**	2.469*	15.195***
p50-p80	0.4811***	0.5337***	2.689	0.695	
p60-p80	0.4216***	0.4892***	2.298	0.658	
p70-p80	0.3199***	0.5565***	5.360*	0.886	
p90-p80	-0.073	0.2199	1.783	0.282	

			Older (30–65) workers		
p10-p80	0.8162***	0.6882***	0.302	0.106	
p20-p80	0.7588***	0.5089**	2.907	0.683	
p30-p80	0.703***	0.3534	6.502**	1.608	
p40-p80	0.6059***	0.1641	13.727***	5.089***	1.013
p50-p80	0.5541***	-0.2082	33.715***	13.313***	0.268
p60-p80	0.4684***	-0.011	16.372***	7.709***	0.047
p70-p80	0.247***	0.1803	2.413	0.995	
p90-p80	-0.0787	-0.3732	3.941	1.685	
Year fixed effect	Yes	Yes			
Group of district fixed effects	Yes	Yes			
Trends	Yes	Yes			

*** p<0.01, ** p<0.05, * p<0.1
Source: Authors' estimation of data from LFS 2011, 2012, 2013 and 2014

Returning to the results for different percentiles of subgroups, we first evaluate the validity of estimation for each. For results of endogeneity test as well as validity of instruments of other percentiles for female, young and older worker subgroups, we have either no endogeneity or valid instruments for endogenous cases, except the 40th percentile for young workers. Therefore, we have unbiased estimation results for most percentiles of the three subgroups.

Comparing the results for young and older worker subgroups, the effective minimum wage has stronger effects for young workers although the positive effect, that is, "compression", is found in both subgroups. The effect is significant only for the gaps between the 10th and 20th percentiles and the 80th percentile for older workers. The effect is significant up to the 70th percentile for young workers. In addition, the magnitudes of the effect are larger for young workers; this is understandable because their wages are lower than those of older workers and therefore more likely to be affected by the minimum wage.

3.7 Conclusions and policy implications

Vietnam has experienced significant increases in minimum wages since 2008. The increases for the domestic sector were significantly higher than for the FDI sector due to past differences between minimum wages in the FDI and

domestic sectors. The minimum wages of different sectors were aligned in 2012, and have since increased considerably.

The current paper investigates the impact of increases in minimum wages on employment and wage distribution of different age and gender groups in 2010–14. Specifically, we investigate the impact on total employment, movement between formal and informal sectors, and wage distribution within sectors.

Increases in binding ratios were observed in both formal and informal sectors. The binding ratio in the formal sector was still low in 2014 but was significantly high in the informal sector, as about one-fifth of workers in the sector received wages below their minimum wage applicable. This ratio was three times larger than in 2011. The situation was worse for female workers in the informal sector, although the gap of binding ratios between the two genders was modest in the formal sector. Trends of locations play important roles in determining all features of the labour market under investigation. Inclusion of trends alters the results considerably, both directions of impact and statistical significance of the estimated coefficients in some cases. Therefore, the inclusion of trends is necessary to estimate precisely the impact of minimum wages.

We find that increases in minimum wages have no effect on total employment or movement across types of employment for the whole population or its subgroups. Negative impacts are detected but are all insignificant. The decrease in net increment of working-age population, the weak compliance in the labour market, and workers' compensation already above the minimum wage are factors that partially mitigate the negative impacts of increases in minimum wages on total employment and movement of workers into formal sectors. The insignificant effect on employment is somewhat different to the negative effect reported in previous studies on the topic for Vietnam. However, our alternative specifications detect that the differences can be attributed to the inclusion of trends in the empirical models in the current study.

In terms of impact on wage distribution, increases in minimum wages are found to narrow the gaps between the lower percentiles and the 80th percentile, the percentile that is not affected by minimum wages or the threshold in formal sectors. In addition, the reduction in the gaps decreases for percentiles closer to the threshold. This compression is also found in female, young and older worker subgroups in the formal sectors. The positive effect of the minimum wage on wage distribution is also reported in Hansen, Rand and Torm (2015). However, we find that the effect does not stop at the median, as in that study, but also affects higher percentiles of the wage distribution.

A broader effect is found for the young worker subgroup than for the older

worker subgroup. The effect is found for percentiles that are close to the threshold percentile, and the magnitudes of the effect are larger for young workers, while being detected only for left-end percentiles in the older worker subgroup.

Our findings indicate that increases in minimum wages have not yet had significantly negative effects on the labour market. However, there is a possibility that the labour market could not mitigate the negative impact of further increases in minimum wages. This possibility should be considered in minimum wage policy in the future. Furthermore, the insignificant effect is potentially contributed to by low compliance with regulations. The effect may be different if enforcement is enhanced, especially in the informal sector.

The current paper faces a number of limitations. First, the model for estimating the impact of minimum wages on wage distribution does not work well for the informal sector or the male worker subgroup in the formal sector. Therefore, other models should be employed to investigate the effect in the informal sector and the male subgroup. It is important to investigate the effect in the informal sector, given its large size in Vietnam. Second, although we include trends of locations in the empirical models, time-variance economic conditions of locations as proxies for the demand side of local labour markets should be controlled for in the estimation. Third, we focus only on investigating effects of increases in minimum wages on the labour market in general but not the mechanisms, the behaviour of stakeholders or other aspects. Minimum wages can be also linked to other aspects of firms' operations and workers' behaviour. For instance, on firms' side, minimum wages can influence investment decisions, for example, replacement of labour by equipment that can induce increases in labour productivity. On labour's side, increases in minimum wages may affect workers' decisions on investing in skills and productivity.

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Annex: Data cleaning

As only wages are available in LFS, only wage earners are kept. Then we follow the data cleaning procedure of Hansen, Rand and Torm (2015) with some modifications. Consistencies in typical personal characteristics are first checked. Observations are surveyed twice (identifying via household and personal ID); differences in age or education across surveys larger than 1 are dropped. Duplicate observations that are inconsistent in birth year, gender or ethnicity are also dropped. In the last step, duplicate observations of birth year, gender, ethnicity and working sector (and age or education differences by one unit is allowed) are collapsed into one with the mean characteristics of the two observations.