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Do Minimum Wages Affect Firms' Labor and Capital?

Evidence from Vietnam

Nguyen Viet Cuong¹

Abstract

This study measures the effect of minimum wage increases on firm outcomes using fixed-effects regression and panel data from Vietnam Enterprise Censuses during 2008-2010. It is found that minimum wages reduce firms' labor size, albeit at a small magnitude. A one percent increase in real minimum wages leads to a 0.1 percent reduction in the number of workers of firms. Firms are more likely to reduce male workers and those without social insurance. As a result, the proportion of female workers and workers with social insurance in firms increases due to minimum wages. Interestingly, under pressure of minimum wages, firms tend to increase assets, especially fixed assets, for labor substitution.

JEL Classification: J31; L25; P42

Keywords: minimum wages, firms, impact evaluation, panel data, Vietnam.

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1. Introduction

Economists as well as policy makers have been long interested in the effect of minimum wages. A reason why the minimum wage is of interest is its possible negative effects. Positive effects of minimum wages are to prevent labor exploitation, to increase labor productivity, increase income and consumption, and to reduce the number of people covered by social programs (Freeman, 1994; Dolado et al., 2000; Dowrick and Quiggin, 2003; Gunderson, 2005). However, minimum wages can lead to negative effects such as unemployment, production stagnation and increased prices.

The negative effect of minimum wages that concerns most economists and policy makers is employment reduction. In a competitive labor market, a rise in wage can lead to an increase in labor supply and a reduction in labor demand. There will be an excess in labor supply, and as a result, unemployment will be increased. Minimum wages can be harmful to a group of workers, especially the low-wage workers. However, in the “new minimum wage research”, minimum wages are not always harmful to employment (Bazen, 2000; Neumark and Wascher, 2007). The effect of minimum wages is negligible if minimum wages are close to competitive wages or the elasticity of labor demand is less sensitive to wages (Dickens et al., 1995, and 1999).

Firms are the main employers in the economy. Since minimum wages can affect the labor cost and labor demand, minimum wages can also have an influence on firm performance. If higher production cost caused by minimum wages is passed to consumers, firms are not affected or affected negligibly by minimum wages. This case can happen for industries with very low price elasticity of demand. In a competitive market, the higher production cost cannot be passed fully to the consumers. In this case, the firms can respond to the minimum wages in two ways. The first way is to reduce the labor demand to keep the labor cost unchanged. In the second way, firms do not reduce the labor demand, and they are burdened with the higher labor cost due to increased minimum wages (Draca et al., 2011).

The effect of minimum wages on firm performance is unknown a priori. In the short-run, the sign and the magnitude of the minimum wage effect depend on firms' ability to pass the higher labor cost to consumers and firms' response to the labor demand. Empirical studies are ambiguous about the effect of minimum wages on employment and

prices. Negative effects of minimum wages on employment are found in a large number of empirical studies (see review by Brown et al., 1982; Brown, 1999; Card and Krueger, 1995; Neumark and Wascher, 2007; Lemos, 2008), while no effects or even positive effects of minimum wage on employment are found in other studies such as Katz and Krueger (1992), Card and Krueger (1994, 2000), Montenegro and Pages (2004), Rama (2001). Likewise, a positive effect of minimum wages on prices is found in several studies, e.g., Card and Krueger (1995), Aaronson (2001), Macdonald and Aaronson (2000), but other studies such as Frye and Gordon (1981), Katz and Krueger (1992), Card and Krueger (1995) find very small or insignificant effects of minimum wages on prices.²

Although there are numerous empirical studies on the effect of minimum wages on employment as well as price in both developed and developing economies (Neumark and Wascher, 2007; Lemos, 2008), there are only a few studies on the effect of minimum wages on firms' business performance and the effect of minimum wages on firms found in these studies are not consistent. Draca et al. (2011) measures the effect of minimum wages on firm profitability in the United Kingdom using difference-in-differences method and find a negative effect of minimum wages on firm profitability. However, Nguyen (2009a) finds no effects of minimum wages on firm profits in Vietnam. Pacheco and Naiker (2007) do not find a significant effect on minimum wages on profits in New Zealand.

To my knowledge, there have been no studies on the effect of minimum wages on non-labor capital of firms. Labors and capital can be complementary and substitutionary. If labor and capital are perfectly substituted, firms can substitute physical capital for low-wage workers (Draca et al., 2011). As a result, capital can be increased due to minimum wages. In case in which labor and capital are perfectly complementary, if minimum wages decrease labor, capital can be also reduced. However, Bauducco and Janiak (2012) show that minimum wages can increase both labor and capital when labor and capital are perfectly complementary.

² For review of the effect of minimum wages in developing countries, see Cunningham (2007), Eyraud and Saget (2005), Kristensen and Cunningham (2006), Maloney and Mendez (2003) and World Bank (2006), Neumark and Wascher (2007), Lemos (2008).

This study aims to examine the effect of minimum wages of firm outcomes including the number and structure of laborers, labor cost, and assets in Vietnam. There have been 12 adjustments of monthly minimum wages in Vietnam since 1994. Before 2008, there was only a common national minimum wage in Vietnam. Since 2008, there have been four levels of minimum wages applied for four different regions. Higher nominal minimum wages are applied in the better-off regions, while lower nominal minimum wages are applied in the worse-off regions. The increase in real minimum wages during 1994-2008 was rather low, at around 5 percent annually. This growth rate was lower than the GDP growth rate during the same period, and it is possible that minimum wages were lower than market wages. However, since 2008 the real minimum wage has been rising remarkably, with the annual growth rate of around 15 percent. During the current economic slowdown, minimum wage increases can have harmful effects on firms' performance.

In Vietnam, minimum wage increases always lead to debates about possible harmful impacts of minimum wages. There are some people favoring minimum wage increases (Duy, 2009; Can, 2009), while others worry about effects of minimum wages on labor cost and inflation (Thai, 2009; Minh, 2010). There are several quantitative studies on the impact of minimum wages in Vietnam. Nguyen (2011) measures the effect of minimum wages on monthly Consumer Price Index (CPI) during 1994-2008 and does not find a significant effect of minimum wage on CPI. Nguyen (2009b) uses household surveys to measure the effect of minimum wage adjustment in 2005 on employment and find a negative effect of minimum wages on formal employment. Nguyen (2009a) also investigates the effect of the minimum wage adjustment in 2005 but on firm profitability using enterprise surveys. He does not find an effect on the minimum wage adjustment on firms' profit.

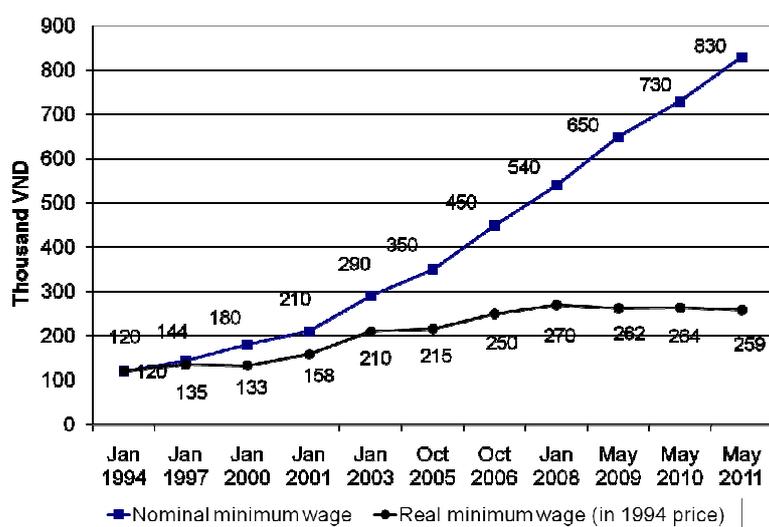
Unlike Nguyen (2009a, 2009b) which examine the effect of the minimum wage increase in 2008, this study investigates the effect of the minimum wage increases on firms during the 2008-2010 period in Vietnam. Compared with Draca et al. (2011), Nguyen (2009a), and Pacheco and Naiker (2007), this study measures the effect of minimum wages on not only labor but also labor cost and assets of firms.

This paper is structured into six sections. The second section reviews the minimum wages in Vietnam. The third section presents the data sets and descriptive statistics of firms in Vietnam. The fourth and fifth sections present the estimation method and empirical results, respectively. Finally, the sixth section concludes.

2. Minimum wages in Vietnam

In Vietnam, the Labor Law regulates that minimum wages are required to guarantee the minimum living standard for a worker. Minimum wages are adjusted when there is inflation and improvement in living standards of people. There are several points of minimum wages in Vietnam that should be noted. Firstly, there is only monthly minimum wages in Vietnam. The government is considering the issue of hourly or daily minimum wages in the near future. Secondly, different minimum wages are applied for domestic employers and foreign employers. The minimum wages of workers (both Vietnamese and foreign workers) in the foreign sector are higher than those in the domestic sector. Thirdly, before 2008 there was a common minimum wage for the domestic sector. This minimum wage is also used to construct the wage scale for workers in public sector (including civil servants and workers in State-owned enterprises). The lowest wage is the minimum wage level, while higher wages are set equal to the minimum wage level multiplied by a coefficient. Since 2008 there have been different minimum wages for different regions. However, there is still a so-called ‘a basic wage’ for wage scale of the public sector. Figure 1 shows nominal and real minimum wages during 1994-2006, and the nominal and real ‘basic wage’ during 2008-2010.

Figure 1: Monthly minimum wages for the domestic sector in Vietnam (thousand VND)



Source: Author's preparation based on the data on minimum wages

Actual minimum wages are set independently of the basic wage. Table 1 presents the nominal minimum wages for different regions since 2008.³ The nominal minimum wages increased at a higher rate than the inflation rate. Thus, real minimum wages increased slightly by around 5 percent over the period 2008-2011.

It should be noted that the minimum wage level for the period 2008-2011 have been planned by the government from 2008 (MOLISA, 2008). Since 2008, minimum wages have been constructed using a basic need approach (Tran et al., 2009). The basic needs include food and non-food consumption. The food consumption is required to ensure 2300 kcal/day for an adult and 1600 kcal/day for a child. Tran et al. (2009) estimate regional minimum wages which allow for food consumption of an adult and a child plus some sufficient non-food consumption. These minimum wages are estimated using the Vietnam Household Living Standard Survey in 2006, and they are constructed for the period 2008-2010 using the predicted CPI deflators.

Table 1: Regional nominal minimum wages (thousand VND)

Minimum wage regions	Domestic sector				Foreign sector			
	2008	2009	2010	2011	2008	2009	2010	2011
Region 1: Urban districts of Hanoi and Ho Chi Minh city (region 1)	620	800	980	2000	1000	1200	1340	2000
Region 2: Several rural areas of Hanoi and Ho Chi Minh city, districts of large cities	580	740	880	1780	900	1080	1190	1780
Region 3: other rural areas of Hanoi, districts of small cities, and others	580	690	810	1550	900	950	1040	1550
Region 4: Other areas	540	650	730	1400	800	920	1000	1400

Note: In 2008, there were three minimum wage levels for three regions. Since 2009, there have been four minimum wage levels for four regions.
Source: Author's preparation based on the data on minimum wages.

3. Data set and firms in Vietnam

3.1. Enterprise census

³ For detailed definition of minimum wage regions, see Government of Vietnam (2009).

The data used in this study are from the most recent Vietnam Enterprise Censuses in 2008, 2009 and 2010 (abbreviated as EC 2008, EC 2009 and EC 2010). These censuses were conducted by General Statistical Office of Vietnam. The censuses covered all registered enterprises throughout the country. The number of observations in EC 2008, EC 2009 and EC 2010 is 205689, 233235 and 287896, respectively. It is interesting that these censuses set up panel data. The unbalanced panel data include 547733 observations, in which there are 155590 observations from EC 2008, 205833 observations from EC 2009 and 186310 observations from EC 2010. All the monetary variables are adjusted into the January 2008 price to eliminate the inflation effect.

The Enterprise Censuses collect rather detailed information on firms' business activities. Information includes type of firms, main business industries, the number of workers, male and female workers, workers with social insurance, labor cost, assets, turnover and profit of firms.

Table 2 shows the percentage of enterprises by geographic areas, ownership types, main business industry and labor size. The number of firms increased remarkably during 2008-2010. Most enterprises are located in urban areas, big cities, provinces in delta regions. Half of the enterprises lie in the two largest cities, Hanoi capital and Ho Chi Minh city. Other provinces and cities that have high concentration of firms, especially foreign invested firms are Hai Phong, Dong Nai and Binh Duong. By ownership type, the (private) limited companies account for the largest proportion, followed by private firms and joint-stock firms. The firms with foreign investment and State firms have much a much lower number. Most firms have small labor sizes. Around 60 percent of firms have less than 10 workers. Big firms with more than 300 workers account for around 2 percent.

Table 2: Distribution of firms by basic characteristics

	2008	2009	2010
<i>Rural/Urban</i>			
Rural	25.26	25.73	24.49
Urban	74.74	74.27	75.51
<i>Regions</i>			
Northern Mountains	5.62	5.38	5.02
Red River Delta	29.89	27.28	28.98
Central Coast	15.11	15.84	15.38
Highland	3.18	3.25	2.85
South East	35.75	37.91	38.67
Mekong River Delta	10.44	10.34	9.10
<i>Provinces</i>			
Ha Noi	19.25	16.65	18.59

	2008	2009	2010
Hai Phong	2.40	2.55	2.33
Binh Duong	2.60	2.86	2.83
Dong Nai	2.99	3.19	2.73
Ho Chi Minh city	28.12	29.30	30.65
Other provinces	44.64	45.44	42.87
<i>Firm type</i>			
State	1.58	1.48	1.20
Collective	6.59	5.53	4.50
Private	22.60	20.53	17.45
Limited company	50.28	53.17	55.93
Joint-stock	16.31	16.48	18.40
Foreign	2.64	2.81	2.53
<i>Business industry</i>			
Agriculture	4.11	3.86	3.33
Food manufacturing and Processing	3.11	2.86	2.44
Garment and textile	2.72	2.63	2.51
Wood and papers	2.27	2.21	1.93
Manufacture and mining	13.42	13.04	11.73
Construction	13.74	14.20	14.77
Trade	39.26	38.71	39.14
Services	21.37	22.48	24.14
<i>Firm size</i>			
1-5	30.61	30.18	33.72
6-10	30.94	32.20	30.00
11-30	23.55	22.37	21.70
31-100	9.32	9.65	9.33
101-300	3.65	3.75	3.52
Above 300	1.93	1.85	1.73
All firms	100%	100%	100%
Source: Estimation from EC 2008, EC 2009 and EC 2010.			

3.2. Firm characteristics

Table 3 and 4 present the main characteristics of firms in the data set. The labor size of firms decreased from 36 laborers to 33 laborers during 2008-2010 (Table 3). One possible reason is that there were a large number of firms established in 2010. These newly established firms often have a small size. Firms in cities with industrial zones such as Dong Nai and Binh Duong tend to have larger labor sizes. State-owned firms, foreign-invested firms, and firms in textile, garment and process have a larger number of workers than other firms.

There is a large variation in wages between different types of firms. Workers in firms in delta regions and large cities tend to have higher wages. Wages in State and foreign firms and firms in industrial and trade sectors are higher than private firms and firms in other sectors.⁴

Table 3: Labor and wages in firms

	The number of workers			Average wage (million VND/worker)		
	2008	2009	2010	2008	2009	2010
<i>Rural/Urban</i>						
Rural	41.4	40.4	39.8	1.38	1.66	1.92
Urban	34.6	33.2	30.9	2.12	2.26	2.67
<i>Regions</i>						
Northern Mountains	39.7	40.7	42.3	1.35	1.63	1.83
Red River Delta	38.6	40.5	34.9	2.01	2.22	2.90
Central Coast	31.7	29.9	28.9	1.27	1.48	1.67
Highland	34.5	31.5	33.3	1.58	1.82	1.97
South East	38.6	34.9	33.3	2.48	2.54	2.85
Mekong River Delta	27.1	27.5	28.5	1.21	1.49	1.56
<i>Provinces</i>						
Ha Noi	29.5	32.7	26.8	2.38	2.66	3.53
Hai Phong	52.2	49.9	45.4	1.67	1.79	2.07
Binh Duong	115.9	100.2	92.1	2.08	2.28	2.37
Dong Nai	60.6	55.3	58.1	1.8	2.39	2.28
Ho Chi Minh city	27.6	25.6	25.1	2.63	2.63	2.96
Other provinces	37.5	35.6	35.4	1.3	1.55	1.74
<i>Firm type</i>						
State	397.4	370.5	361.2	2.82	3.31	3.70
Collective	20.0	20.8	20.6	0.77	0.89	1.01
Private	12.3	12.4	12.6	1.44	1.63	1.74
Limited company	21.5	20.4	19.7	2.07	2.15	2.53
Joint-stock	47.7	48.1	43.8	2.29	2.45	3.01
Foreign	275.3	252.9	259.7	3.64	4.35	4.80
<i>Business industry</i>						
Agriculture	40.3	37.0	36.7	0.66	0.76	0.85
Food manufacturing and Processing	79.0	79.7	81.9	1.35	1.58	1.70
Garment and textile	230.2	213.9	207.8	1.63	1.67	1.92
Wood and papers	45.1	43.0	42.1	1.34	1.55	1.64
Manufacture and mining	68.2	69.0	69.1	1.66	1.96	2.17
Construction	42.7	40.8	39.3	1.93	2.13	2.58
Trade	12.0	12.0	11.6	1.95	2.12	2.60
Services	24.0	23.7	22.2	2.47	2.55	2.82
<i>Firm size</i>						
1-5	3.8	3.8	3.7	1.88	1.99	2.43

⁴ There is no data on wages for each worker in the data set. The average wage per workers is calculated by the total payment of firms for workers divided by the number of workers.

	The number of workers			Average wage (million VND/worker)		
	2008	2009	2010	2008	2009	2010
6-10	7.8	7.7	7.8	1.92	2.08	2.52
11-30	17.8	17.9	17.9	1.9	2.08	2.42
31-100	53.9	53.6	53.5	2.01	2.32	2.58
101-300	171.0	169.7	169.2	2.17	2.53	2.68
Above 300	892.7	859.2	845.2	2.31	2.64	2.86
All firms	36.2	35.0	33.1	1.93	2.1	2.49

Note: The monetary variables are measured in the Jan 2008 price.
Source: Estimation from EC 2008, EC 2009 and EC 2010.

The proportion of workers with social insurance and female workers is just around 30 percent. These proportions are stable during 2008-2010. From the EC data set, we are not able to know the proportion of female workers having social insurance. In urban areas and large cities, the proportion of workers having social insurance is higher than rural areas and other cities. Interestingly, workers in Northern region are more likely to have social insurance.

Table 4: The proportion of workers with social insurance and female workers (%)

	% workers with social insurance			% female workers		
	2008	2009	2010	2008	2009	2010
<i>Rural/Urban</i>						
Rural	31.99	31.28	32.50	31.66	32.56	32.64
Urban	38.00	34.76	38.97	35.70	36.21	36.72
<i>Regions</i>						
Northern Mountains	41.50	42.30	43.88	29.71	31.45	32.79
Red River Delta	32.30	34.28	34.42	35.12	36.18	36.56
Central Coast	30.74	30.35	29.02	33.51	34.67	34.19
Highland	26.15	26.98	27.98	34.55	33.88	33.11
South East	44.39	36.91	44.43	36.38	36.77	37.52
Mekong River Delta	19.16	19.84	22.40	32.11	30.64	30.27
<i>Provinces</i>						
Ha Noi	32.28	33.86	35.41	36.17	37.57	37.87
Hai Phong	29.48	29.79	33.53	34.93	37.10	35.72
Binh Duong	50.63	48.16	44.67	36.81	37.42	35.59
Dong Nai	36.88	29.53	30.86	32.68	33.17	31.61
Ho Chi Minh city	45.14	37.23	45.84	36.81	37.18	38.42
Other provinces	29.45	29.94	29.95	32.67	33.05	33.07
<i>Firm type</i>						
State	89.28	89.87	90.28	32.64	32.49	32.58
Collective	42.69	46.79	44.92	22.73	24.96	25.41
Private	22.36	18.68	23.55	36.80	36.63	36.65
Limited company	35.59	31.21	36.25	34.88	35.39	36.06
Joint-stock	39.52	39.32	40.32	33.07	34.01	34.30

	% workers with social insurance			% female workers		
	2008	2009	2010	2008	2009	2010
Foreign	81.74	81.81	81.90	48.82	48.95	49.42
<i>Business industry</i>						
Agriculture	46.09	49.64	45.69	20.47	21.32	21.78
Food manufacturing and Processing	39.97	38.41	39.88	39.38	39.18	40.14
Garment and textile	49.29	48.98	50.25	66.46	66.12	66.10
Wood and papers	37.78	37.05	38.86	34.81	35.89	35.56
Manufacture and mining	47.95	46.32	49.90	28.83	30.31	31.23
Construction	25.58	27.98	26.87	19.42	20.52	20.01
Trade	32.14	27.58	34.96	37.67	38.15	38.96
Services	42.82	38.66	40.43	39.75	39.96	40.04
<i>Firm size</i>						
1-5	27.16	22.25	31.64	38.64	39.73	39.28
6-10	31.22	29.24	33.51	34.31	34.84	35.20
11-30	44.71	43.21	39.81	30.73	31.07	31.71
31-100	54.45	54.38	53.25	30.23	30.51	32.00
101-300	64.38	62.78	61.24	35.76	35.06	35.82
Above 300	72.43	74.25	72.65	46.91	46.74	46.21
All firms	36.73	34.02	37.58	34.72	35.30	35.74

Source: Estimation from EC 2008, EC 2009 and EC 2010.

4. Impact estimation strategy

Impact evaluation of a policy or a program is always challenging. Measuring the effect of minimum wages is difficult for at least two reasons. Firstly, minimum wages are often a national program and there are no clean control groups who are not absolutely affected by minimum wages. Secondly, minimum wages are not randomly assigned, but based on CPI and other economic and political variables. The most popular method to measure the effect of minimum wages is difference-in-differences estimators (see review by Neumark and Wascher, 2007). Other methods with better identification strategies are instrumental variables and discontinuity regression. The instrumental variable estimator is traditional in impact evaluation, however, finding a valid instrumental variable for minimum wages is not easy. The discontinuity estimator has been applied recently (e.g., Dube et al., 2010) when there is a clear-cut selection of subjects exposed to minimum wages and those not exposed to minimum wages.

In this study, we use fixed-effects regression to measure the effect of minimum wages in Vietnam. More specifically, we assume an outcome of firms as the following function:

$$\ln(Y_{ikt}) = \beta_0 + T_t\beta_1 + X_{ikt}\beta_2 + \ln(MW_k)\beta_3 + X_{ikt}\ln(MW_k)\beta_4 + v_{ijk} + u_{ijkt}, \quad (1)$$

where, Y_{ikt} is a performance indicator of firm i (for example labor size or turnover) in region k (four regions) at the time t . T_t is the dummy variable of year t . X_{ikt} is a vector of firm characteristics. MW_k is the minimum wage level in region k . v_{ijk} and u_{ijkt} are unobserved variables that are time-invariant and time-variant, respectively. This function is rather popular in studies of minimum wages (see Neumark and Wascher, 2007).

We use similar specifications as equation (1) to measure the effect of minimum wages on different outcomes of firms including labor size, labor cost and assets. In other words, we use regress different firm outcomes (dependent variables) on the same set of explanatory variables. Most dependent variables are in the logarithm form. Some dependent variables such as the ratio of female workers to total workers are not in the logarithm form.

It should be noted that we use the variable of logarithm of real minimum wages. We do not use the Kaitz index or any ratio of minimum wages to average wages. Since the average wages can be also affected by minimum wages, and this makes it difficult to interpret the effect of minimum wages on firm outcomes. However, we still control for the regional average wage of the previous years. The minimum wages vary across four regions and foreign and domestic sectors. For each year, there are eight levels of minimum wages. This definition of minimum wages is different from those of Nguyen (2009b) and Draca (2011). Nguyen (2009b) measures the effect of the minimum wage increase in 2005. In 2005, there was only a common minimum wage in Vietnam, and there is no information on the number of workers below the minimum wage in firms in data sets. Thus, in Nguyen (2009b), firms that have the average wage below the minimum wage are defined as the treatment group, while those that have the average wage above the minimum wage are defined as the control group. A problem is that the control groups can also include firms that have a number of workers below the minimum wage.

The explanatory variables X include exogenous variables that should not be affected by minimum wages (Heckman et al., 1999; Angrist and Pischke, 2008). Minimum wages are adjusted mainly based on the CPI, the living cost of regions, and the

average wages of regions. These variables can affect firm activities and should be controlled for. Thus the explanatory variables include regional CPI, the provincial gross output of agriculture, service and industry per capita, the labor force of provinces (the total number of people above 14 years old), and the average wages of regions.⁵ The agricultural, industrial and service output per capita are proxies of living standards. Explanatory variables are in the logarithm form. We use lagged variables (the previous year variables) so that they are not affected by minimum wages of the current year.

The difficulty in measuring minimum wages is the endogeneity of minimum wages in outcome equations. Unobserved variables can affect both minimum wages and firm outcomes. In this study, we are not able to find a convincing instrument for minimum wages in Vietnam. Discontinuity estimators cannot be applied since minimum wages are adjusted simultaneously throughout the country. Thus in this study, we use fixed-effects regression to estimate the effect of minimum wages. Fixed-effects regression eliminates the time-invariant unobserved variables v_{ik} . It is expected that the bias caused by the endogeneity of minimum wages will be negligible after elimination of the time-invariant unobserved variables and control of main observed variables that affect minimum wages (CPI and regional outputs). In addition, the minimum wages have been set up by the government of Vietnam since 2008 (MOLISA, 2008), and this fact can cause more exogenous variables in the minimum wages in the equation of firm outcomes.

5. Estimation results

5.1. The impact of minimum wages: no interactions

This section presents the estimation results of minimum wage effects on firm outcomes. In this section, we do not include interactions between the minimum wage variable with other firm characteristics in regressions. In the next section, we will include interactions between the minimum wage variable with other firm characteristics to examine whether the effect of minimum wages differs for different types of firms.

⁵ There are 4 regions of minimum wages, but there are 8 geographical regions in Vietnam. In regressions, we control for the CPI of 8 regions.

Tables 5 and 6 present the fixed-effects regressions of firm performances on minimum wages and other explanatory variables. Several dependent variables are in a logarithm form.⁶ Variables that are fixed over time such as regions and firm types are removed in fixed-effects regressions.

A problem in panel data model is serial correlation of error terms. Although the serial correlation does not affect the biasness of estimators, it can affect the validity of the standard error of the estimators. Using a serial correlation test of Wooldridge (2010), the hypothesis on no serial correlation in our regressions is strongly rejected. Thus, we use the fixed-effect regressions with Driscoll-Kraay standard errors that are robust to serial correlation and heteroskedastic (Driscoll and Kraay, 1998; Hoechle, 2007).

Table 5 shows that minimum wages have a small and negative effect on the labor size of firms. A one-percent increase in real minimum wages reduces the number of workers by 0.1 percent. It implies that if the average labor size of firms is around 33, a one-percent increase in real minimum wages can reduce the average labor size by approximately 0.033 worker. This effect is small, compared with the effect found in empirical studies in the United States in which a one-percent increase in minimum wages lead to a 0.1 to 0.3 percent reduction in employment (Brown et al., 1982; Brown, 1999; Card and Krueger, 1995; Neumark and Wascher, 2007).

Interestingly, minimum wages have a small effect on labor composition of firms. A one-percent increase in real minimum wages increase the proportion of female workers and workers with social insurance by around 0.06 and 0.21 percentage points, respectively. The findings imply that firms tend to reduce the number of workers without social insurance instead of workers with social insurance. Workers without social insurance are more likely to have low skills and short-term labor contracts. Firing workers who have social insurance is often more complicated in terms of legal labor regulations. Male workers are more likely to be reduced due to minimum wages. This finding is difficult to interpret since male workers might be more likely to have higher skills. Further

⁶ For double log functions, the effect of minimum wages is measured by coefficient of $\ln(MW_k)$, and the estimated coefficient is interpreted as the elasticity of dependent variables with respect to minimum wage. When dependent variables are in a linear form (not in the logarithm form): as the minimum wage level changes by 1 percent, the value of the dependent variables changes by the coefficient of $\ln(MW_k)$ divided by 100 (see Wooldridge, 2011).

studies are needed to understand the channel through which minimum wages can affect different type of workers.⁷

The average wage per worker increases due to minimum wages. However, the increase is very small. A one-percent increase in minimum wages leads to 0.076 percent increase in the average wages. This might be because the proportion of workers who receive wages below the minimum wages is small, and the minimum wages only have a positive effect on wages of these low-wage workers. Since minimum wages have a small effect on labor size and wages per laborer, the effect of the minimum wages on total labor cost of firms is very small and not statistically significant.

Table 5: Regressions of laborers and wages

Explanatory variables	Dependent variables				
	Log of the number of workers	Proportion of female workers	Proportion of workers with social insurance	Log of wage per worker	Log of total wage cost
Log of minimum wage	-0.102** (0.044)	0.059*** (0.002)	0.218*** (0.042)	0.076** (0.023)	-0.001 (0.074)
Year 2009	-0.012** (0.006)	0.009*** (0.003)	0.006*** (0.001)	0.215*** (0.019)	0.203*** (0.023)
Year 2010	0.029*** (0.009)	0.014*** (0.004)	0.053*** (0.007)	0.334*** (0.023)	0.366*** (0.029)
Log of regional CPI in previous year	0.246*** (0.046)	0.026*** (0.005)	0.024 (0.040)	-0.121*** (0.023)	0.135** (0.064)
Log of lagged labor force of provinces	-0.071*** (0.011)	-0.024 (0.015)	-0.070*** (0.005)	-0.420*** (0.061)	-0.519*** (0.060)
Log of lagged gross output of agriculture per capita of provinces	0.336*** (0.040)	-0.033** (0.013)	0.227** (0.088)	0.185** (0.074)	0.496*** (0.120)
Log of lagged gross output of industry per capita of provinces	0.003 (0.015)	-0.007** (0.003)	-0.006 (0.013)	0.134*** (0.041)	0.136** (0.060)
Log of lagged gross output of service per capita of provinces	0.014 (0.034)	0.005* (0.003)	0.015*** (0.005)	0.019*** (0.002)	0.035 (0.035)
Log of lagged regional average wages	0.059* (0.036)	-0.017 (0.011)	-0.236*** (0.021)	-0.419*** (0.122)	-0.335** (0.150)
Constant	1.856*** (0.171)	0.175 (0.199)	1.603*** (0.180)	16.752*** (0.769)	18.383*** (0.803)
Observations	547,733	547,733	547,733	547,733	547,733
Within R-squared	0.002	0.004	0.027	0.079	0.057
The number of firms	205,834	205,834	205,834	205,834	205,834

⁷ In the data sets, there are no data on wages on workers by skills or education.

Explanatory variables	Dependent variables				
	Log of the number of workers	Proportion of female workers	Proportion of workers with social insurance	Log of wage per worker	Log of total wage cost
Note: All monetary variables are measured in the January 2008 price.					
*** p<0.01, ** p<0.05, * p<0.1.					
Robust Driscoll-Kraay standard errors in parentheses.					
Source: Estimation from EC 2008, EC 2009 and EC 2010.					

Table 6 presents the regressions of firms' assets or non-labor capitals. Interestingly, minimum wages lead to an increase in firm assets and the ratio of fixed assets to total assets.⁸ More specifically, a one-percent increase in minimum wages leads to a 0.75 percent increase in total assets and a 0.86 percent increase in fixed assets. The proportion of fixed assets to total assets rises by 0.176 percentage points as the minimum wages increase by one percent. Possibly, firms tend to increase assets to substitute labor to mitigate the effect of minimum wages on labor cost.

Table 6: Regressions of assets

Explanatory variables	Dependent variables				
	Log of asset	Log of asset per worker	Log of fixed asset	Log of fixed asset per worker	Proportion of fixed asset to total asset
Log of minimum wage	0.752*** (0.058)	0.858*** (0.101)	1.205*** (0.080)	1.275*** (0.122)	0.176*** (0.010)
Year 2009	0.060*** (0.007)	0.072*** (0.012)	0.042** (0.022)	0.057** (0.021)	-0.002 (0.004)
Year 2010	0.240*** (0.021)	0.209*** (0.014)	0.262*** (0.009)	0.231*** (0.008)	-0.015 (0.010)
Log of regional CPI in previous year	0.316*** (0.080)	0.071** (0.034)	0.803** (0.287)	0.517 (0.324)	0.077** (0.034)
Log of lagged labor force of provinces	0.038 (0.138)	0.106 (0.134)	0.124 (0.093)	0.189** (0.093)	-0.018* (0.010)
Log of lagged gross output of agriculture per capita of provinces	0.591*** (0.154)	0.253** (0.127)	0.461** (0.169)	0.121 (0.139)	-0.030* (0.017)
Log of lagged gross output of industry per capita of provinces	-0.081*** (0.016)	-0.084*** (0.025)	-0.191*** (0.020)	-0.187*** (0.030)	-0.031*** (0.003)
Log of lagged gross output of service per capita of provinces	-0.027 (0.054)	-0.042* (0.027)	-0.083 (0.096)	-0.096 (0.069)	-0.023*** (0.006)
Log of lagged regional average wages	0.255*** (0.036)	0.197*** (0.012)	-0.067** (0.011)	-0.138*** (0.030)	-0.076** (0.034)
Constant	5.762*** (0.409)	3.868*** (0.362)	1.655 (1.559)	0.290 (1.809)	-0.250 (0.143)

⁸ Fixed assets are non-current and physical assets such as plant and equipments.

Explanatory variables	Dependent variables				
	Log of asset	Log of asset per worker	Log of fixed asset	Log of fixed asset per worker	Proportion of fixed asset to total asset
Observations	547,733	547,733	547,733	547,733	547,733
Within R-squared	0.076	0.067	0.041	0.035	0.004
The number of firms	205,834	205,834	205,834	205,834	205,834

Note: All monetary variables are measured in the January 2008 price.
*** p<0.01, ** p<0.05, * p<0.1.
Robust Driscoll-Kraay standard errors in parentheses.
Source: Estimation from EC 2008, EC 2009 and EC 2010.

5.2. The impact of minimum wages: with interactions

To examine the effect of minimum wages for different types of firm, we include interactions between the minimum wage variable and characteristics variables of firms. Table 7 and Table 8 present only the estimates of the minimum wage variable and these interaction terms.⁹

It shows that the minimum wage effect on firm outcomes differs between urban and rural areas and regions. The minimum wage effect on wages per worker is higher in rural areas. Minimum wages help rural workers increase their wages.

Table 7: Regressions with interactions between minimum wages and demographic variables

Explanatory variables	Dependent variables					
	Log of the number of workers	Proportion of female workers	Proportion of workers with social insurance	Log of monthly wages per worker	Log of total asset	Proportion of fixed asset to total asset
Model with interaction between minimum wages and urban						
Log of minimum wages	-0.153*	0.046***	0.268***	0.314***	0.952***	0.095***
	(0.080)	(0.004)	(0.036)	(0.042)	(0.069)	(0.013)
Log of minimum wages * Urban	0.046	0.012***	-0.045***	-0.217***	-0.183**	0.074***
	(0.031)	(0.002)	(0.008)	(0.021)	(0.073)	(0.004)
Model with interaction between minimum wages and regions						
Log of minimum wages	0.212**	0.101**	0.249**	0.705**	0.472**	-0.000
	(0.079)	(0.022)	(0.090)	(0.145)	(0.181)	(0.021)
Log of minimum wages * Northern Mountain	Omitted					

⁹ The full regressions are not reported in this paper but can be provided on request.

Explanatory variables	Dependent variables					
	Log of the number of workers	Proportion of female workers	Proportion of workers with social insurance	Log of monthly wages per worker	Log of total asset	Proportion of fixed asset to total asset
Log of minimum wages * Red River Delta	-0.314*** (0.027)	-0.038 (0.038)	0.009 (0.023)	-0.290** (0.147)	0.319 (0.225)	0.071*** (0.010)
Log of minimum wages * Central Coast	-0.039 (0.031)	-0.078** (0.033)	0.076*** (0.008)	-0.376*** (0.056)	0.063 (0.107)	0.179*** (0.029)
Log of minimum wages * Highlands	-0.100 (0.087)	-0.136*** (0.017)	-0.012* (0.070)	-0.853*** (0.103)	0.957*** (0.043)	-0.003 (0.090)
Log of minimum wages * South East	-0.346*** (0.081)	-0.041** (0.020)	-0.088 (0.141)	-1.005*** (0.114)	0.268*** (0.081)	0.274*** (0.024)
Log of minimum wages * Mekong River Delta	-0.147*** (0.020)	-0.185*** (0.009)	0.019 (0.020)	-0.434** (0.171)	0.118 (0.151)	0.112** (0.052)
Model with interaction between minimum wages and provinces						
Log of minimum wages	0.219*** (0.071)	-0.003 (0.009)	0.307** (0.049)	0.372*** (0.090)	0.648*** (0.147)	0.094*** (0.012)
Log of minimum wages * Hanoi	-0.288*** (0.010)	0.073** (0.026)	-0.071 (0.082)	0.091 (0.082)	0.141 (0.290)	0.009 (0.013)
Log of minimum wages * Hai Phong	-0.345*** (0.037)	0.038 (0.037)	0.124*** (0.039)	-0.337 (0.165)	0.409** (0.185)	-0.141*** (0.027)
Log of minimum wages * Binh Duong	-0.761*** (0.081)	-0.080** (0.038)	0.143** (0.049)	-0.022 (0.122)	-0.239 (0.370)	0.020 (0.070)
Log of minimum wages * Dong Nai	-0.171 (0.117)	-0.074* (0.042)	-0.401*** (0.094)	-0.104 (0.315)	-0.297** (0.104)	0.143*** (0.009)
Log of minimum wages * Ho Chi Minh city	-0.355*** (0.053)	0.066** (0.010)	-0.124 (0.098)	-0.473*** (0.080)	0.054** (0.027)	0.185*** (0.008)
Log of minimum wages * Other provinces	Omitted					

Note: All monetary variables are measured in the January 2008 price.
*** p<0.01, ** p<0.05, * p<0.1.
Standard errors in parentheses.
Source: Estimation from EC 2008, EC 2009 and EC 2010.

The effect of minimum wages on labor size of firms tends to be higher in large cities and delta regions than mountain and highland regions and other provinces.

The minimum wage effect on firm outcomes varies across firms of different types. Minimum wages have no effect on labor demand of foreign-invested firms. State firms, private firms and limited companies are those most affected by minimum wages on the labor sizes. By industry, firms in construction, trade and service sectors are less likely to be affected by minimum wages.

Table 8 also examines whether the effect of minimum wages differs for firms of different labor sizes and firms of different asset sizes by including interactions between the minimum wage variables and the labor size in 2008 and the assets in 2008. We use the

variables 2008 since they are not affected by minimum wage during 2008-2010. It shows that the minimum wage effect on the number of laborers is higher for firms with a large labor size than those with a small labor size.

Table 8: Regressions with interactions between minimum wages and characteristics variables of firms

Explanatory variables	Dependent variables					
	Log of the number of workers	Proportion of female workers	Proportion of workers with social insurance	Log of monthly wages per worker	Log of total asset	Proportion of fixed asset to total asset
Model with interaction between minimum wages and type of firms						
Log of minimum wages	-0.913*** (0.089)	0.052*** (0.004)	0.120 (0.094)	-0.024 (0.156)	-1.078*** (0.175)	0.000 (0.063)
Log of minimum wages * State firms	0.163*** (0.055)	-0.060** (0.009)	-0.023 (0.044)	-0.123** (0.051)	-0.100** (0.043)	0.163*** (0.054)
Log of minimum wages * Collectives	Omitted					
Log of minimum wages * Private firms	0.456*** (0.122)	-0.037*** (0.010)	0.065 (0.089)	0.056 (0.076)	1.682*** (0.159)	0.112** (0.046)
Log of minimum wages * Limited company	0.723*** (0.103)	0.008 (0.008)	0.109* (0.056)	0.141** (0.073)	1.709*** (0.219)	0.176*** (0.056)
Log of minimum wages * Joint-stock company	1.046*** (0.149)	0.013*** (0.003)	0.131*** (0.012)	0.326*** (0.083)	2.119*** (0.048)	0.156** (0.061)
Log of minimum wages * firms with FDI	1.173*** (0.082)	-0.091*** (0.029)	0.343*** (0.075)	0.661*** (0.213)	-0.063 (0.545)	0.039* (0.021)
Model with interaction between minimum wages and business industry of firms						
Log of minimum wages	-0.128 (0.084)	0.035*** (0.010)	0.221** (0.087)	-0.014 (0.148)	0.652*** (0.126)	0.113*** (0.007)
Log of minimum wages * agriculture	-0.558*** (0.135)	0.013 (0.009)	-0.172** (0.030)	-0.263*** (0.071)	-3.098*** (0.122)	0.007 (0.065)
Log of minimum wages * Food processing	-0.357*** (0.025)	-0.041*** (0.010)	-0.067** (0.029)	0.557*** (0.059)	0.406*** (0.003)	-0.075*** (0.012)
Log of minimum wages * Garment and textile	-0.455** (0.176)	-0.203*** (0.023)	0.039* (0.021)	0.211* (0.135)	0.004 (0.168)	-0.079** (0.034)
Log of minimum wages * Wood and paper	-0.451*** (0.077)	0.054*** (0.015)	-0.014** (0.007)	0.306*** (0.004)	-0.117 (0.118)	0.028 (0.018)
Log of minimum wages * Production and mining	-0.290*** (0.035)	0.085*** (0.009)	0.024 (0.060)	0.290*** (0.066)	0.083 (0.118)	-0.044** (0.022)
Log of minimum wages * Construction	0.265*** (0.015)	0.079*** (0.025)	0.065 (0.066)	0.445*** (0.080)	-0.089*** (0.028)	0.130*** (0.017)
Log of minimum wages * Trade	0.066*** (0.005)	0.023*** (0.003)	-0.009 (0.074)	0.147 (0.120)	0.030 (0.273)	0.119*** (0.006)
Log of minimum wages * Transport and services	Omitted					
Model with interaction between minimum wages and firms' labor size						
Log of minimum wages	2.242*** (0.580)	0.008 (0.012)	0.166** (0.069)	-0.139 (0.080)	2.068*** (0.144)	0.247*** (0.012)

Explanatory variables	Dependent variables					
	Log of the number of workers	Proportion of female workers	Proportion of workers with social insurance	Log of monthly wages per worker	Log of total asset	Proportion of fixed asset to total asset
Log of minimum wages * log of the number of laborers in 2008	-0.968*** (0.197)	0.020*** (0.003)	0.028 (0.046)	0.124** (0.049)	-0.532*** (0.059)	-0.029*** (0.003)

Note: All monetary variables are measured in the January 2008 price.
*** p<0.01, ** p<0.05, * p<0.1.
Standard errors in parentheses.
Source: Estimation from EC 2008, EC 2009 and EC 2010.

6. Conclusions

Minimum wage increases often lead to debate on possibly harmful effects on employment, prices and enterprises in Vietnam. Nguyen (2009a, 2009b) do not find a significant effect of the minimum wage increase in 2005 on employment of low-wage workers and profit of firms. A possible explanation is that the increase in the real minimum wage is very small in 2005, at around 2 percent. Since 2008, the real minimum wages have been increasing largely, at around 15 percent annually. The effect of minimum wages in the recent period can be different from the effect of minimum wages in the previous period. Thus, this study examines the effect of minimum wages on firm outcomes during the period 2008-2010 using data from Vietnam Enterprise Censuses 2008, 2009 and 2010.

Unlike Nguyen (2009a, 2009b), we find significant effects of minimum wages on labor size and assets of firms. More specifically, a one-percent increase in real minimum wages leads to around a 0.1 percent reduction in the number of workers of firms. Male workers and workers without social insurance (low-skill and low-wage workers are less likely to have social insurance) are more likely to be affected by minimum wage increases. The average wage per worker is increased due to minimum wages, albeit at a very small magnitude. Since minimum wages reduce the number of workers and increase the wage per worker, there is no effect of the minimum wages on total labor cost of firms.

Under the pressure of minimum wages, firms tend to increase assets, especially fixed assets. To some extents, assets might be substituted for labor so that the minimum wage effects on labor cost can be reduced.

The effect of minimum wages differs for firms in different regions and firms of different types. Overall, firms in large cities and delta regions, firms with large size of

labor tend to be more affected by minimum wages. By ownership types, private firms and limited companies are more likely to be affected by minimum wages than other firms.

When there is a large increase in minimum wages, minimum wages can have a harmful effect on firms in Vietnam. Although, this effect remains rather low, it can be higher if minimum wages increases by a large amount. Thus, when adjusting the minimum wage, the government of Vietnam should considering its possible unfavorable effects on firm performance.

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