Do Minimum Wage Increases Matter to Profitability of Private Firm? The Case of Vietnam

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Do Minimum Wage Increases Matter to Profitability of Private Firm? The Case of Vietnam

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Abstract

This paper measures the impact of a minimum wage increase on profitability of private firms in Vietnam using a difference-in-differences with propensity score matching method. Data used for this analysis are from Vietnam Enterprise Censuses in 2005 and 2006. It is found that the impact estimate of the minimum wage increase in 2005 from 290 to 350 thousand VND on firms' profit margins is very small and negative, and not statistically significant.

JEL Classification: J31; L25; P42

Keywords: Minimum wage, firm profitability, difference-in-differences, propensity score matching, Vietnam.

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1. Introduction

Minimum wages are the lowest hourly, daily or monthly wage that employers are required to pay to employees. Increasing minimum wages often leads to controversial impacts. Possible positive effects of minimum wages are protection of low income laborers, increases in work incentives and productivity, reduction of people covered in subsidy programs, increases in consumption, aggregate demand and generation of multiplier effects (Freeman, 1995; Dowrick and Quiggin, 2003; Gunderson, 2005). Since firms can respond to an increase in labor cost by reducing labor demand or increasing the output prices, negative impacts of minimum wage increases can be increased unemployment and prices (Hamermesh, 1986; Brown, 1999).

The size as well as the sign of the impact of minimum wage increases on employment and prices is not consistent in empirical studies. For example, negative effects of the minimum wage on employment are found in studies both developed countries (Neumark and Wascher, 2002 and 2003; Campolieti et al., 2005; Magan and Johnston, 1999; Abowd et al., 1999) and developing countries (Rama, 2001; Gindling and Terrell, 2004; Harrison and Scorse, 2005). On the contrary, positive effects on employment of minimum wages are found in studies such as Card and Krueger (1994, 2000), Dickens et al. (1999), Montenegro and Pages (2004), Singell and Terborg (2006).[2] Similarly, strong effects of minimum wages on inflation are found in Card and Krueger (1995), Macdonald and Arasonson (2000), but not in Frye and Gordon (1981), Sellekaerts (1981), Katz and Krueger (1992), Card and Krueger (1995).[3]

Minimum wages can affect profitability of firms in two ways. The profit margins of firms are not affected substantially if firms can pass on higher production cost due to increased minimum wages to consumers or the firms can reduce the production cost by employing fewer workers. On the contrary, the profit margins of the firms will decreases if the higher wage costs are not fully passed or the firms do not reduce their employment (Draca, et al. 2008). The effect of minimum wages on firm profitability is a priori unknown. Although there are a large number of empirical studies on impacts of minimum wages on employment and prices, there are only a few empirical studies on the relationship between minimum wages and firm profitability. Recently, Draca et al. (2008) showed that the minimum wages reduced firm profitability significantly in UK.

[2] Neumark and Wascher (2007) present detailed review of studies on the minimum wage and employment.
[3] Lemos (2004) reviews studies on the impact of minimum wages on prices.

In Vietnam, there have been nine times of increasing the minimum wage since the year 1993. The real minimum wage increased by around 118 percent during the period 1994-2009. Increasing minimum wages often leads to debates about impacts of minimum wage increases. The government states that minimum wages are constructed with consultation from enterprises. Thus increases in minimum wages would have small effects on production, business and employment (Duy Tuan, 2009). On the contrary, there are critics that increased minimum wages can increase production costs and lead to burdens to enterprises (Thai Uyen, 2009). However, there have been no quantitative studies on the impact of minimum wage increases on firm profitability in Vietnam.

The main objective of this paper is to measure the impact of minimum wage increases on firm profitability in Vietnam. The method of impact measurement used in this paper is difference-in-differences with propensity score matching, and the data are from Enterprise Censuses (EC) of Vietnam in years 2005 and 2006. These censuses were conducted by General Statistics Office of Vietnam. The censuses covered all State enterprises, collectives, private and foreign enterprises throughout the country. The number of observations in the 2005 and 2006 ECs is 113,352 and 131,975, respectively. It is interesting that we are able to construct a panel data set of 97,306 enterprises through these ECs. The EC contains data on the main production and business characteristics of enterprises such as labor, labor cost, investment capital, assets, revenues and profits, taxes and other contributions to State, etc.

The remainder of this paper is organized as follows. Section 2 introduces the minimum wages in Vietnam. Section 3 describes the methodology of impact evaluation. Section 4 presents impacts of the minimum wage increase on firm profitability. Finally, section 5 concludes.

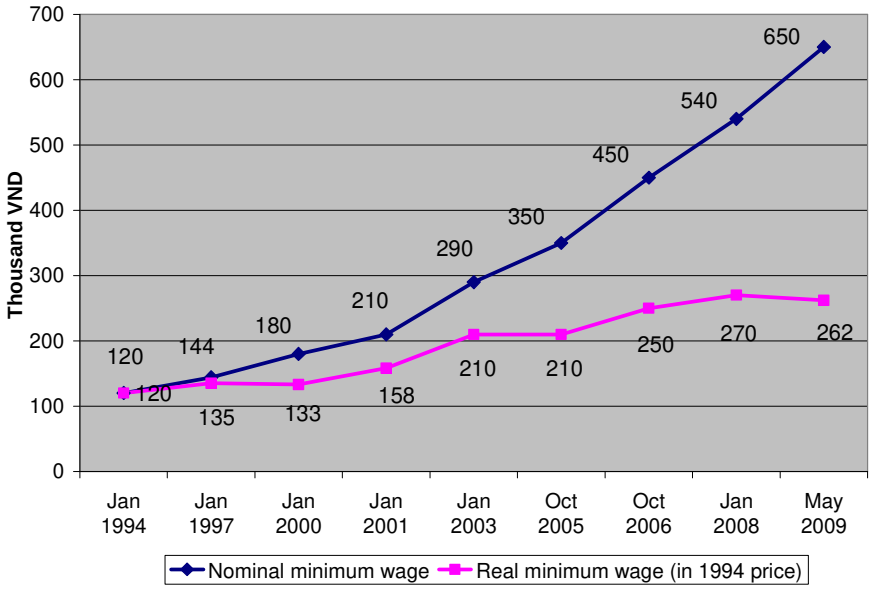
2. Minimum wage and enterprises in Vietnam

According to the Labor Law of Vietnam, the minimum wage is set up to cover “the basis of the cost of living of an employee who is employed in the most basic job with normal working conditions, and includes remuneration for the work performed and an additional amount for contribution towards savings”. It should be noted that Vietnam has only minimum monthly wage, not minimum daily or hourly wage. The Labor Law of Vietnam also regulates that the government must adjust the minimum wage when “the price index increases, resulting in the reduction of the real wages of employees”. In addition,

minimum wage adjustments are also based on payment capacity of the State budget, since there are a large proportion of employees in the State sector.

Since the year 1993, there were nine adjustments of the minimum monthly wage in Vietnam. All of these adjustments are increases in the minimum wage. The time and the national minimum wages (both nominal and real) after the adjustments are presented in Figure 1.

Figure 1: Minimum monthly wage in Vietnam (thousand VND)



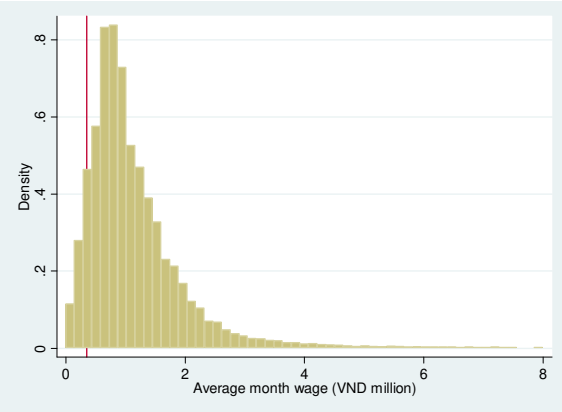
In this paper, we will examine the impacts of the increased in the national minimum wage from 290 to 350 thousand VND in October 2005, since the data available at the time of writing the paper are Enterprise Censuses 2005 and 2006. Because of firm-level data, there are no data on wages of individual laborers, thus no data on the number of laborers paid below minimum wages. Instead, we have data on the average wages of firms' laborers. Firms that have the average wages of laborers below increased minimum wages will be affected by minimum wage increases. In this paper, we assume that firms with the average wages of laborers below 350 thousand VND can be affected as the minimum wage increased from 290 to 350 thousand VND, and these firms are regarded as a treatment group.

A problem in measuring the impact of minimum wage increases is how to define a control group which is not affected by minimum wage increases. A large number of State enterprises construct their salary scale for laborers according to minimum wages. It means that as minimum wages increase laborers in State enterprises who have wages

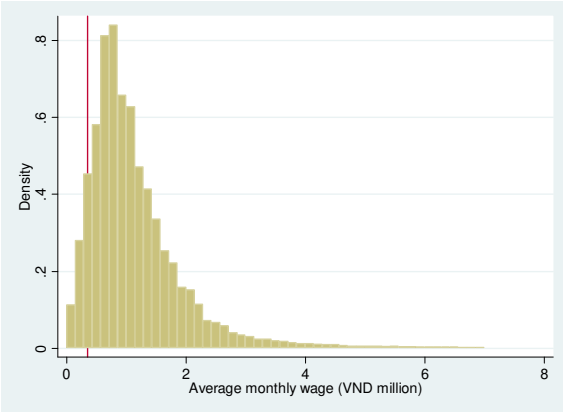
above the new minimum wages might also receive higher wages or higher social insurances. For foreign firms, there are different minimum wages, which are higher than the national minimum wages. Thus the control group should not include the State firms as well as the foreign firms. Figure 1 displays the distribution of firms by their average labor wages. For all enterprises including State, private and foreign ones, around 8.2 percent of the enterprises have the average wage below 350 thousand VND in 2005. When the State firms and the foreign firms are excluded, this percentage is around 6.6 percent. The two panels of Figure 2 show very similar distributions. However, in 2006, there were still 2.8 percent of private firms the average wage below 350 thousand VND. It means that there were firms which paid their workers below minimum wages. This figure casts doubt on the effectiveness of minimum wages in Vietnam.

Figure 2: Distribution of the average labor wage

All enterprises



Private enterprises



Source: Estimation from EC 2005.

Private firms which have average wages of laborers above 350 thousand VND can be affected by the minimum wage increase, since these firms can have laborers paid below 350 thousand VND. However, it is expected that firms with high average labor wages are less likely to have laborers with wages below 350 thousand VND, thus less likely to be affected by the minimum wage increase. We will use different thresholds to define the control groups to examine the sensitivity of impact estimates of the minimum wage increase to the definition of control groups. More specifically, control groups include private firms which have the average wages for laborers higher than different thresholds: 350, 600, 800, 1000, and 1200 thousand VND.

To short, the treatment and control groups in this paper are private firms. The treatment group includes firms having the average wages below 350 thousand VND in

the year 2005, while the control group includes firms having the average wages above different thresholds ranging from 350 to 1200 thousand VND in the year 2005.

3. Impact evaluation method

It is not possible to attribute the differences in profitability between enterprises having labor wages below the minimum wage and other enterprises to the effect of a minimum wage increase, since the two groups are likely to differ in other respects. To measure the impact of the minimum wage increase on the firm profitability, we used the methodology of difference-in-indifferences with propensity score matching. In the following section, we discuss this method and the indicators used.

Let *D* be a binary variable, which is equal to 1 if a firm has labor wages below the minimum wage, and 0 otherwise. Further, denote *Y* as the variable of interest, with $Y_i = Y_{i1}$ if firm *i* has average labor wages below the minimum wage and $Y_i = Y_{i0}$ if the same firm *i* had not had average labor wages below the minimum wage. The outcome of interest in this paper is profit margin which is equal to the ratio of profits to sales.

The impact of the minimum wage increase on firm *i* is then measured by:

$$\Delta_i = Y_{i1} - Y_{i0}. \qquad (1)$$

The most popular parameter in impact evaluation is Average Treatment Effect on the Treated, which is defined by (Heckman et. al., 1999):

$$ATT = E(Y_1 - Y_0 | D = 1) = E(Y_1 | D = 1) - E(Y_0 | D = 1). \qquad (2)$$

ATT measures the average effect of the minimum wage increase on firms with the average wage below the minimum wage.

Estimation of ATT is not straightforward, since $E(Y_0 \mid D = 1)$ is unobservable. $E(Y_0 \mid D = 1)$ is the counterfactual which is the expected profit margins of treatment firms if these firm had the average wage above the minimum wage. We use a matching methodology to derive a comparison group, which can mimic the treatment group in the absence of the minimum wage increase. We use the method of propensity score matching (Rosenbaum and Rubin, 1983). We start by estimating the probability of being a firm having the average wage for laborers below the minimum wage using a logit or probit model (this is called propensity scores), $P(D_{it} = 1) = F(X_{it-1})$, where *X* is a vector of observed variables before the minimum wage increases. The matching methodology

matches each firm having the average wage for laborers below the minimum wage to "comparable" firms having the average wage for laborers above the minimum wage based on the closeness of the predicted propensity scores. The matching estimator is defined as follows:

$$\hat{ATT} = \sum_{i \in Treatment} \left[y_i - \sum_{j \in Control} g(\hat{p}_i, \hat{p}_j) y_j \right], \quad (3)$$

where p is predicted propensity scores and $g(.)$ gives the weights on control firm j in forming a comparison with treated firm i. The function $g(.)$ differs for the different matching estimators proposed in the literature.

Since we have longitudinal data on enterprises, we can estimate the impact of the minimum wage increase by using the method of difference-in-differences with matching. The main advantage of the difference-in differences method compared to the standard matching estimator in levels is that the former eliminates differences in the variable of interest due to unobserved time-invariant effects. This implies that the difference-in differences method controls for selection on both observables and time-invariant unobservables, while the standard matching method controls for selection on observables only. Let Δy be the differences between the variable of interest before and after the minimum wage increase. Then the difference-in-differences estimator is given by:

$$\hat{ATT} = \sum_{i \in Treatment} \left[\Delta y_i - \sum_{j \in Control} g(\hat{p}_i, \hat{p}_j) \Delta y_j \right]. \quad (4)$$

We use different matching estimators including nearest-neighbors and kernel matching to examine the sensitivity the impact estimates. Standard errors are calculated using bootstrap techniques. This is common practice in empirical studies. Although Abadie and Imbens (2006) show that bootstrap can give invalid standard errors for the nearest neighbor matching estimator, and there is no evidence on the validity of bootstrap standard errors for other matching estimators.

4. Impact estimation results

4.1. Performance of matching

As mentioned above, this paper examines the impact of the increase in the minimum wage from 290 to 350 thousand VND in October 2005. The EC data in 2005 are used as the baseline data before the minimum wage increase. The minimum wage increase came into effect from October 2005, and the effect of the minimum wage increase on the firm profitability of the whole year 2005 would be very negligible. We do not use the 2004 EC as baseline data since the wage and profitability can be changed substantially during 2004-2005. The 2006 EC data are used as data after the minimum wage increase.

The first step in measuring impact is to predict the propensity score, which is the probability that a firm had the average wages of laborers below 350 thousand VND in 2005. Since the dependent variable is binary, we used logit regression. Control variables should affect both the firm profitability and the average wage of firms' laborers. The control variables should be exogenous to the treatment variable, thus these variables were measured in 2005, i.e., before the minimum wage increases in October 2005. Pre-treatment outcome (profit margin in 2005) can be used as control in the regression of the propensity score (Dehejia and Wahba, 1998; Smith and Todd, 2005). Table A1 in the Appendix presents the entire set of explanatory variables, and their means and standard errors of the means.

Table 1 presents the logit regressions of the probability that a firm had the average wages of laborers below 350 thousand VND in 2005. It shows that firms in the fishery and transportation sector are less likely to pay low wages for their employees. On the contrary, firms in sectors of manufacture, construction and hotels tend to have the average wages for workers below the minimum wage. As expected, firms with a large number of employees are more likely to have lower wages for their employees. Higher values of fixed assets and revenues tend to reduce the probability of having the average wages of laborers below the minimum wage. As expected, workers in urban areas and the rich cities, Hanoi and Ho Chi Minh city.

Table 1: Logit regression

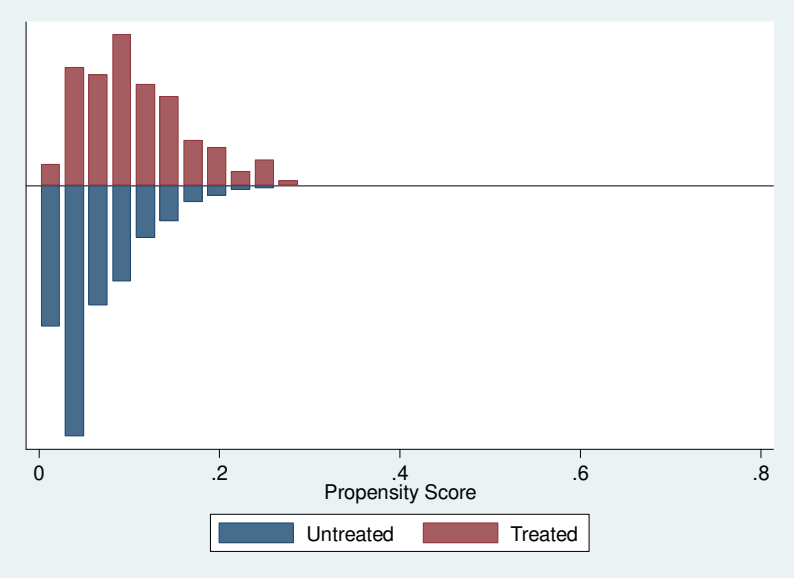
Explanatory variables	Control group having monthly wage above 350 thousand VND	Control group having monthly wage above 600 thousand VND	Control group having monthly wage above 800 thousand VND	Control group having monthly wage above 1000 thousand VND	Control group having monthly wage above 1200 thousand VND
Agriculture	0.1781	0.2512	0.3235*	0.4159**	0.5281**
	[0.1533]	[0.1640]	[0.1779]	[0.1971]	[0.2179]
Fishery	-0.2952**	-0.3553***	-0.4216***	-0.4872***	-0.5137***
	[0.1172]	[0.1209]	[0.1264]	[0.1361]	[0.1456]
Mining	-0.0139	-0.0256	-0.0616	-0.0827	-0.1188
	[0.1036]	[0.1079]	[0.1131]	[0.1217]	[0.1291]
Manufacture	0.3040***	0.3576***	0.4097***	0.4989***	0.5928***
	[0.0364]	[0.0377]	[0.0395]	[0.0420]	[0.0446]
Electricity, water	0.0222	0.0263	0.0856	0.1647	0.2269
	[0.1316]	[0.1378]	[0.1493]	[0.1657]	[0.1813]
Construction	0.0973**	0.0804**	0.0542	0.0088	0.0231
	[0.0391]	[0.0404]	[0.0421]	[0.0443]	[0.0466]
Trade	-0.0055	-0.0063	0.0104	0.0652*	0.1172***
	[0.0346]	[0.0357]	[0.0373]	[0.0392]	[0.0411]
Hotel	0.5801***	0.6913***	0.9193***	1.3146***	1.6607***
	[0.0741]	[0.0766]	[0.0806]	[0.0871]	[0.0949]
Transportation	-0.2364***	-0.2826***	-0.3786***	-0.5200***	-0.6220***
	[0.0547]	[0.0561]	[0.0578]	[0.0604]	[0.0635]
Finance	0.1952	0.2174	0.2248	0.3272	0.4078
	[0.2143]	[0.2254]	[0.2381]	[0.2647]	[0.2900]
Private enterprises	Omitted				
Limited liability company	-0.0047	-0.0166	-0.0546*	-0.1320***	-0.1878***
	[0.0255]	[0.0266]	[0.0280]	[0.0305]	[0.0330]
Joint-stock company	0.0873**	0.0881**	0.0742*	-0.0117	-0.0547
	[0.0360]	[0.0375]	[0.0395]	[0.0425]	[0.0456]
Joint-stock company with less than 50% State capital	-0.2505**	-0.2853**	-0.3505***	-0.4319***	-0.6095***
	[0.1159]	[0.1191]	[0.1238]	[0.1338]	[0.1424]
Number of laborers	0.0008***	0.0011***	0.0013***	0.0019***	0.0026***
	[0.0001]	[0.0001]	[0.0001]	[0.0002]	[0.0002]
Fixed assets (billion VND)	-0.0188***	-0.0223***	-0.0237***	-0.0313***	-0.0312***
	[0.0045]	[0.0047]	[0.0049]	[0.0055]	[0.0057]
Basic construction capital (billion VND)	0.0092*	0.0082*	0.0069	0.0041	0.0044
	[0.0047]	[0.0048]	[0.0049]	[0.0053]	[0.0066]
Revenues (billion VND)	-0.0347***	-0.0400***	-0.0447***	-0.0494***	-0.0528***
	[0.0018]	[0.0019]	[0.0019]	[0.0020]	[0.0021]
Red River Delta	Omitted				
North East	-0.1257***	-0.1766***	-0.1858***	-0.2122***	-0.1896***
	[0.0425]	[0.0448]	[0.0480]	[0.0531]	[0.0583]
North West	-0.1066	-0.1809*	-0.2605**	-0.3351***	-0.3687***
	[0.0959]	[0.0998]	[0.1043]	[0.1132]	[0.1215]
North Central Coast	-0.1665***	-0.2117***	-0.2241***	-0.2449***	-0.2234***
	[0.0470]	[0.0497]	[0.0533]	[0.0594]	[0.0657]

Explanatory variables	Control group having monthly wage above 350 thousand VND	Control group having monthly wage above 600 thousand VND	Control group having monthly wage above 800 thousand VND	Control group having monthly wage above 1000 thousand VND	Control group having monthly wage above 1200 thousand VND
South Central Coast	-0.2041***	-0.2638***	-0.3048***	-0.3689***	-0.3460***
	[0.0421]	[0.0444]	[0.0472]	[0.0522]	[0.0573]
Central Highlands	-0.2523***	-0.3237***	-0.3290***	-0.4017***	-0.4741***
	[0.0690]	[0.0718]	[0.0770]	[0.0842]	[0.0907]
South East	-0.3594***	-0.4682***	-0.5647***	-0.7169***	-0.7927***
	[0.0424]	[0.0443]	[0.0468]	[0.0511]	[0.0549]
Mekong River Delta	-0.4173***	-0.4672***	-0.4933***	-0.5447***	-0.5441***
	[0.0459]	[0.0483]	[0.0519]	[0.0576]	[0.0633]
Urban	-0.1417***	-0.1799***	-0.2348***	-0.2849***	-0.3071***
	[0.0246]	[0.0258]	[0.0275]	[0.0301]	[0.0327]
HCM city	-0.1549***	-0.1668***	-0.1809***	-0.2304***	-0.2871***
	[0.0412]	[0.0424]	[0.0442]	[0.0472]	[0.0499]
Hanoi	-0.7403***	-0.8317***	-0.8915***	-1.0531***	-1.1289***
	[0.0358]	[0.0375]	[0.0397]	[0.0433]	[0.0468]
Constant	-0.9876***	-0.7762***	-0.5259***	-0.1644***	0.0692
	[0.0468]	[0.0492]	[0.0521]	[0.0567]	[0.0610]
Observations	43793	38160	31732	25351	20553
R-squared	0.09	0.11	0.14	0.18	0.22

Robust standard errors in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%
Source: Estimation from ECs 2005 and 2006

To examine the common support, we present Figures 3 of the propensity scores. The bars above the horizontal line represent the density distribution of the propensity score of firms with the average wages of laborers below the minimum wage, while the bars below the horizontal line represent the density distribution of the propensity score of firms with the average wages of laborers above the minimum wage. The figure shows that the common support is large. This means that for each treated firm we will be able to find non-treated firms with similar propensity scores.

Figure 3: Predicted propensity scores



Source: Estimation from EC 2005

It should be noted that the main aim of the predicted propensity score is to overcome the multidimensionality problem of matching by covariates. The quality of a constructed comparison group should be assessed by testing whether the distribution of the covariates is similar between the comparison and treatment groups given the predicted propensity score. We test the equality of means of covariates between treatment and comparison firms using t-tests. To examine the sensitivity of the impact estimates to different matching schemes, we will use three matching estimators including 1 nearest neighbor, 5 nearest neighbors, kernel matching with bandwidth of 0.05. The results of the balancing test for these estimators are presented in Tables A3 to A10 in Appendix I. It can be seen that the number of covariates that we cannot reject the equality of their means between treatment and comparison groups is higher kernel matching. So we will use the results from the kernel matching scheme in the remainder of this paper the interpretation. Results from other nearest neighbor estimators are very similar and presented in Appendix 1.

4.2. Impact estimates

Table 2 present impact estimates of the minimum wage increase on profit margin using kernel neighbor matching with bandwidth of 0.05. Before the minimum wage increase, firms having the average labor wages below the minimum wage have higher profit

margin than firms having the average labor wages above the minimum wage. This is reasonable, since the low wages for laborers imply low production costs and higher ratios of profit to revenues. After the minimum wage increase, the control group still have higher profit margin than the treatment group. However, the difference is smaller and not statistically significant. Overall, the estimates of the impact on the profit margins from the difference-in-differences estimator are negative but not statistically significant. The size of the estimates is very small.

Table 2: Impact of the minimum wage increase on profit margin – kernel neighbor matching with bandwidth of 0.05

Control group	Before the minimum wage increase			After the minimum wage increase			Diff-in-diff
	Y1	Y0	Y1-Y0	Y1	Y0	Y1-Y0	
	(1)	(2)	(3)=(1)-(2)	(4)	(5)	(6)=(4)-(5)	(7)=(6)-(3)
Control group having monthly wage above 350 thousand VND	0.02121***	0.02066***	0.00056***	0.02305***	0.02284***	0.00021	-0.00035
	[0.00078]	[0.00133]	[0.00082]	[0.00075]	[0.00091]	[0.00108]	[0.00107]
Control group having monthly wage above 600 thousand VND	0.02121***	0.02063***	0.00058***	0.02305***	0.02265***	0.00040	-0.00018
	[0.00078]	[0.00129]	[0.00080]	[0.00075]	[0.00093]	[0.00112]	[0.00107]
Control group having monthly wage above 800 thousand VND	0.02121***	0.02045***	0.00077***	0.02305***	0.02283***	0.00022	-0.00055
	[0.00078]	[0.00126]	[0.00079]	[0.00075]	[0.00095]	[0.00112]	[0.00110]
Control group having monthly wage above 1000 thousand VND	0.02121***	0.01983***	0.00138***	0.02305***	0.02230***	0.00074	-0.00064
	[0.00078]	[0.00121]	[0.00088]	[0.00075]	[0.00101]	[0.00118]	[0.00123]
Control group having monthly wage above 1200 thousand VND	0.02121***	0.01931***	0.00190***	0.02305***	0.02178***	0.00127	-0.00063
	[0.00078]	[0.00119]	[0.00092]	[0.00075]	[0.00128]	[0.00143]	[0.00147]

The outcome variable is the ratio of net profit to total sales revenues. The net profit is the difference between total sales revenue and total costs of firms.
Y1 is the outcome of the treatment group which includes private firms having the average wages below 350 thousand VND in the year 2005
Y0 is the outcome of the control group which includes private firms having the average wages above different thresholds ranging from 350 to 1200 thousand VND in the year 2005
* significant at 10%; ** significant at 5%; *** significant at 1%.
Standard errors in bracket (Standard errors are calculated using bootstrap with 500 replications).
Source: Estimation from ECs 2005 and 2006

5. Conclusions

Minimum wages are set up to protect low wage workers from exploitation. In Vietnam, there have been nine increases of the minimum wage since the year 1993. The real minimum wage increased by around 118 percent during the period 1994-2009. Increasing minimum wages is sometime to blame for reducing firm profitability. Higher minimum wages implies higher costs and smaller profit margins. This paper is the first attempt to examine the impact of the minimum wage increases on firm profitability. More specifically, this paper use data from Vietnam Enterprise Census 2005 and 2006 to

measure the impact of the minimum wage increase from 290 to 350 thousand VND in 2005 on profit margins of private firms. The impact measurement method is the difference-in-differences with propensity score matching.

We found that the effect of the increase in the minimum wage on firm profitability is very small. It reduces the firms' profit margins around 1 percent. In addition, the impact estimate is not statistically significant. There can be several explanations for the small and insignificant effect. Firstly, firms are able to adjust the higher costs due to increased minimum wages so that their profit margins are not affected significantly by the minimum wage increase. Secondly, the minimum wages are not effective in Vietnam. As mentioned in section 2, there were at least still 2.8 percent of private firms which paid their employees below the minimum wage in 2006. Some firms do not follow the minimum wages, thus increased minimum wages do not affect their profitability. Thirdly, there can be measurement errors in our data sets. Enterprise census data often have larger measurement errors. In addition, our definition of the treatment variable does not capture the variation of firms' exposure to the minimum wage increase. For example, it is better if the treatment variable is the number of laborers with wages below the minimum level. Finding explanations for the small estimate of the impact of increased minimum wages on the firm profitability is beyond the scope of this study, but certainly important for future research.

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Appendix 1: Tables

Table A.1. Variable description

Variable	Type	Mean	Std. Dev.	Mean	Std. Dev.
Agriculture	Binary	0.0052	0.0719	0.0030	0.0548
Fishery	Binary	0.0062	0.0787	0.0115	0.1066
Mining	Binary	0.0104	0.1014	0.0079	0.0884
Manufacture	Binary	0.3004	0.4585	0.1977	0.3982
Electricity, water	Binary	0.0059	0.0765	0.0050	0.0704
Construction	Binary	0.1715	0.3770	0.1309	0.3373
Trade	Binary	0.3288	0.4699	0.4789	0.4996
Hotel	Binary	0.0721	0.2587	0.0403	0.1967
Transportation	Binary	0.1008	0.3012	0.0921	0.2891
Finance	Binary	0.0024	0.0492	0.0020	0.0445
Private enterprises	Binary	0.2789	0.4486	0.2230	0.4163
Limited liability company	Binary	0.5696	0.4952	0.6199	0.4854
Joint-stock company	Binary	0.1452	0.3523	0.1400	0.3470
Joint-stock company with less than 50% State capital	Binary	0.0062	0.0787	0.0171	0.1298
Number of laborers	Continuous	29.0	79.0	33.8	125.4
Fixed assets (million VND)	Continuous	781.4	2970.0	1650.8	9284.4
Basic construction capital (million VND)	Continuous	193.7	1458.7	185.0	2391.3
Revenues (million VND)	Continuous	1783.6	7991.2	11607.6	93034.9
Red River Delta	Binary	0.3306	0.4705	0.3554	0.4786
North East	Binary	0.0936	0.2913	0.0553	0.2285
North West	Binary	0.0132	0.1140	0.0072	0.0846
North Central Coast	Binary	0.0686	0.2528	0.0425	0.2016
South Central Coast	Binary	0.0929	0.2903	0.0642	0.2452
Central Highlands	Binary	0.0243	0.1539	0.0190	0.1365
South East	Binary	0.3053	0.4606	0.3795	0.4853
Mekong River Delta	Binary	0.0717	0.2581	0.0769	0.2664
Urban	Binary	0.6791	0.4669	0.7976	0.4018
HCM city	Binary	0.2249	0.4176	0.3039	0.4599
Hanoi	Binary	0.1195	0.3245	0.2575	0.4373
Number of observations			2886		40907

Source: Estimation from ECs 2005 and 2006

Table A.2. Balancing tests for 1 nearest neighbor matching

Variable	Sample	Treated	Control	%bias	bias	t	p>t
Agriculture	Unmatched	0.00520	0.00301	3.4		2.03	0.042
	Matched	0.00520	0.00381	2.2	36.7	0.76	0.447
Fishery	Unmatched	0.00624	0.01149	-5.6		-2.60	0.009
	Matched	0.00624	0.00485	1.5	73.6	0.69	0.493
Mining	Unmatched	0.01040	0.00787	2.7		1.47	0.142
	Matched	0.01040	0.01282	-2.5	3.9	-0.83	0.406
Manufacture	Unmatched	0.30042	0.19767	23.9		13.25	0.000
	Matched	0.30042	0.32779	-6.4	73.4	-2.17	0.030
Electricity, water	Unmatched	0.00589	0.00499	1.2		0.66	0.508
	Matched	0.00589	0.00866	-3.8	-206.8	-1.20	0.231
Construction	Unmatched	0.17152	0.13093	11.3		6.20	0.000
	Matched	0.17152	0.16008	3.2	71.8	1.13	0.259
Trade	Unmatched	0.32883	0.47892	-30.9		-15.66	0.000
	Matched	0.32883	0.30180	5.6	82.0	2.14	0.033
Hotel	Unmatched	0.07207	0.04034	13.8		8.18	0.000
	Matched	0.07207	0.08004	-3.5	74.9	-1.10	0.270
Transportation	Unmatched	0.10083	0.09206	3.0		1.57	0.116
	Matched	0.10083	0.10326	-0.8	72.3	-0.29	0.769
Finance	Unmatched	0.00243	0.00198	0.9		0.52	0.606
	Matched	0.00243	0.00208	0.7	22.2	0.27	0.788
Limited liability company	Unmatched	0.56965	0.61987	-10.2		-5.36	0.000
	Matched	0.56965	0.55371	3.3	68.3	1.18	0.238
Joint-stock company	Unmatched	0.14518	0.14000	1.5		0.77	0.438
	Matched	0.14518	0.15974	-4.2	-180.8	-1.49	0.137
Joint-stock company with less than 50% State capital	Unmatched	0.00624	0.01714	-10.2		-4.45	0.000
	Matched	0.00624	0.00624	0.0	100.0	0.00	1.000
Number of laborers	Unmatched	29.043	33.754	-4.5		-1.99	0.047
	Matched	29.043	36.217	-6.8	-52.3	-1.91	0.056
Fixed assets (billion VND)	Unmatched	0.78140	1.65080	-12.6		-5.01	0.000
	Matched	0.78140	0.93703	-2.3	82.1	-1.98	0.048
Basic construction capital (billion VND)	Unmatched	0.19365	0.18503	0.4		0.19	0.848
	Matched	0.19365	0.27935	-4.3	-893.7	-0.93	0.351
Revenues (billion VND)	Unmatched	1.78360	11.60800	-14.9		-5.67	0.000
	Matched	1.78360	2.82780	-1.6	89.4	-4.78	0.000
North East	Unmatched	0.09356	0.05527	14.6		8.52	0.000
	Matched	0.09356	0.10049	-2.6	81.9	-0.86	0.390
North West	Unmatched	0.01317	0.00721	5.9		3.56	0.000
	Matched	0.01317	0.01282	0.3	94.2	0.11	0.911
North Central Coast	Unmatched	0.06861	0.04246	11.4		6.61	0.000
	Matched	0.06861	0.06930	-0.3	97.3	-0.10	0.920
South Central Coast	Unmatched	0.09286	0.06424	10.7		5.98	0.000
	Matched	0.09286	0.09806	-1.9	81.8	-0.65	0.516
Central Highlands	Unmatched	0.02426	0.01899	3.6		1.98	0.047
	Matched	0.02426	0.02772	-2.4	34.1	-0.80	0.424
South East	Unmatched	0.30527	0.37949	-15.7		-7.97	0.000

Variable	Sample	Treated	Control	%bias	bias	t	p>t
	Matched	0.30527	0.29279	2.6	83.2	1.00	0.317
Mekong River Delta	Unmatched	0.07173	0.07691	-2.0		-1.01	0.312
	Matched	0.07173	0.05925	4.8	-140.8	1.85	0.064
Urban	Unmatched	0.67914	0.79759	-27.2		-15.13	0.000
	Matched	0.67914	0.66424	3.4	87.4	1.17	0.244
HCM city	Unmatched	0.22488	0.30386	-18.0		-8.97	0.000
	Matched	0.22488	0.20825	3.8	78.9	1.48	0.138
Hanoi	Unmatched	0.11954	0.25754	-35.8		-16.63	0.000
	Matched	0.11954	0.10880	2.8	92.2	1.24	0.215

Source: Estimation from ECs 2005 and 2006

Table A.3. Balancing tests for 5 nearest neighbor matching

Variable	Sample	Treated	Control	%bias	bias	t	p>t
Agriculture	Unmatched	0.00520	0.00301	3.4		2.03	0.042
	Matched	0.00520	0.00430	1.4	58.9	0.74	0.457
Fishery	Unmatched	0.00624	0.01149	-5.6		-2.60	0.009
	Matched	0.00624	0.00326	3.2	43.3	2.46	0.014
Mining	Unmatched	0.01040	0.00787	2.7		1.47	0.142
	Matched	0.01040	0.01026	0.1	94.5	0.08	0.938
Manufacture	Unmatched	0.30042	0.19767	23.9		13.25	0.000
	Matched	0.30042	0.32571	-5.9	75.4	-3.10	0.002
Electricity, water	Unmatched	0.00589	0.00499	1.2		0.66	0.508
	Matched	0.00589	0.00644	-0.8	38.6	-0.40	0.687
Construction	Unmatched	0.17152	0.13093	11.3		6.20	0.000
	Matched	0.17152	0.16417	2.1	81.9	1.12	0.264
Trade	Unmatched	0.32883	0.47892	-30.9		-15.66	0.000
	Matched	0.32883	0.30395	5.1	83.4	3.04	0.002
Hotel	Unmatched	0.07207	0.04034	13.8		8.18	0.000
	Matched	0.07207	0.08420	-5.3	61.8	-2.57	0.010
Transportation	Unmatched	0.10083	0.09206	3.0		1.57	0.116
	Matched	0.10083	0.10866	-2.7	10.7	-1.45	0.146
Finance	Unmatched	0.00243	0.00198	0.9		0.52	0.606
	Matched	0.00243	0.00194	1.0	-8.9	0.59	0.555
Limited liability company	Unmatched	0.56965	0.61987	-10.2		-5.36	0.000
	Matched	0.56965	0.55024	4.0	61.4	2.22	0.026
Joint-stock company	Unmatched	0.14518	0.14000	1.5		0.77	0.438
	Matched	0.14518	0.15288	-2.2	-48.4	-1.23	0.220
Joint-stock company with less than 50% State capital	Unmatched	0.00624	0.01714	-10.2		-4.45	0.000
	Matched	0.00624	0.00700	-0.7	93.0	-0.53	0.593
Number of laborers	Unmatched	29.043	33.754	-4.5		-1.99	0.047
	Matched	29.043	34.292	-5.0	-11.4	-2.48	0.013
Fixed assets (billion VND)	Unmatched	0.78140	1.65080	-12.6		-5.01	0.000
	Matched	0.78140	0.93694	-2.3	82.1	-3.09	0.002
Basic construction capital (billion VND)	Unmatched	0.19365	0.18503	0.4		0.19	0.848
	Matched	0.19365	0.18600	0.4	11.3	0.19	0.853
Revenues (billion VND)	Unmatched	1.78360	11.60800	-14.9		-5.67	0.000
	Matched	1.78360	2.84140	-1.6	89.2	-7.50	0.000
North East	Unmatched	0.09356	0.05527	14.6		8.52	0.000
	Matched	0.09356	0.09550	-0.7	94.9	-0.38	0.706
North West	Unmatched	0.01317	0.00721	5.9		3.56	0.000
	Matched	0.01317	0.01525	-2.1	65.1	-1.00	0.318
North Central Coast	Unmatched	0.06861	0.04246	11.4		6.61	0.000
	Matched	0.06861	0.06722	0.6	94.7	0.31	0.754
South Central Coast	Unmatched	0.09286	0.06424	10.7		5.98	0.000
	Matched	0.09286	0.09619	-1.2	88.4	-0.65	0.518
Central Highlands	Unmatched	0.02426	0.01899	3.6		1.98	0.047
	Matched	0.02426	0.02682	-1.8	51.3	-0.92	0.356
South East	Unmatched	0.30527	0.37949	-15.7		-7.97	0.000
	Matched	0.30527	0.28836	3.6	77.2	2.10	0.035

Variable	Sample	Treated	Control	%bias	bias	t	p>t
Mekong River Delta	Unmatched	0.07173	0.07691	-2.0		-1.01	0.312
	Matched	0.07173	0.06493	2.6	-31.1	1.53	0.126
Urban	Unmatched	0.67914	0.79759	-27.2		-15.13	0.000
	Matched	0.67914	0.66376	3.5	87.0	1.86	0.063
HCM city	Unmatched	0.22488	0.30386	-18.0		-8.97	0.000
	Matched	0.22488	0.21040	3.3	81.7	1.99	0.046
Hanoi	Unmatched	0.11954	0.25754	-35.8		-16.63	0.000
	Matched	0.11954	0.10631	3.4	90.4	2.38	0.018

Source: Estimation from ECs 2005 and 2006

Table A.4. Balancing tests for kernel matching with bandwidth of 0.05

Variable	Sample	Treated	Control	%bias	bias	t	p>t
Agriculture	Unmatched	0.00520	0.00301	3.4		2.03	0.042
	Matched	0.00520	0.00490	0.5	86.4	0.44	0.663
Fishery	Unmatched	0.00624	0.01149	-5.6		-2.60	0.009
	Matched	0.00624	0.00584	0.4	92.5	0.53	0.594
Mining	Unmatched	0.01040	0.00787	2.7		1.47	0.142
	Matched	0.01040	0.01032	0.1	96.7	0.08	0.935
Manufacture	Unmatched	0.30042	0.19767	23.9		13.25	0.000
	Matched	0.30017	0.30036	0.0	99.8	0.01	0.990
Electricity, water	Unmatched	0.00589	0.00499	1.2		0.66	0.508
	Matched	0.00589	0.00577	0.2	86.2	0.17	0.866
Construction	Unmatched	0.17152	0.13093	11.3		6.20	0.000
	Matched	0.17158	0.16955	0.6	95.0	0.55	0.585
Trade	Unmatched	0.32883	0.47892	-30.9		-15.66	0.000
	Matched	0.32894	0.33468	-1.2	96.2	-1.30	0.194
Hotel	Unmatched	0.07207	0.04034	13.8		8.18	0.000
	Matched	0.07210	0.07213	0.0	99.9	-0.02	0.982
Transportation	Unmatched	0.10083	0.09206	3.0		1.57	0.116
	Matched	0.10087	0.10236	-0.5	83.0	-0.53	0.597
Finance	Unmatched	0.00243	0.00198	0.9		0.52	0.606
	Matched	0.00243	0.00220	0.5	48.3	0.50	0.617
Limited liability company	Unmatched	0.56965	0.61987	-10.2		-5.36	0.000
	Matched	0.56984	0.56682	0.6	94.0	0.60	0.551
Joint-stock company	Unmatched	0.14518	0.14000	1.5		0.77	0.438
	Matched	0.14523	0.15025	-1.4	3.3	-1.49	0.135
Joint-stock company with less than 50% State capital	Unmatched	0.00624	0.01714	-10.2		-4.45	0.000
	Matched	0.00624	0.00791	-1.6	84.7	-2.09	0.037
Number of laborers	Unmatched	29.043	33.754	-4.5		-1.99	0.047
	Matched	28.533	30.377	-1.8	60.9	-1.48	0.139
Fixed assets (billion VND)	Unmatched	0.78140	1.65080	-12.6		-5.01	0.000
	Matched	0.78160	1.01430	-3.4	73.2	-6.72	0.000
Basic construction capital (billion VND)	Unmatched	0.19365	0.18503	0.4		0.19	0.848
	Matched	0.19371	0.23659	-2.2	-397.2	-1.52	0.129
Revenues (billion VND)	Unmatched	1.78360	11.60800	-14.9		-5.67	0.000
	Matched	1.78290	3.79690	-3.1	79.5	-8.06	0.000
North East	Unmatched	0.09356	0.05527	14.6		8.52	0.000
	Matched	0.09359	0.09246	0.4	97.1	0.39	0.694
North West	Unmatched	0.01317	0.00721	5.9		3.56	0.000
	Matched	0.01317	0.01280	0.4	93.7	0.34	0.733
North Central Coast	Unmatched	0.06861	0.04246	11.4		6.61	0.000
	Matched	0.06863	0.06637	1.0	91.4	0.93	0.351
South Central Coast	Unmatched	0.09286	0.06424	10.7		5.98	0.000
	Matched	0.09289	0.09043	0.9	91.4	0.88	0.378
Central Highlands	Unmatched	0.02426	0.01899	3.6		1.98	0.047
	Matched	0.02426	0.02509	-0.6	84.3	-0.56	0.573
South East	Unmatched	0.30527	0.37949	-15.7		-7.97	0.000
	Matched	0.30537	0.30100	0.9	94.1	0.97	0.332

Variable	Sample	Treated	Control	%bias	bias	t	p>t
Mekong River Delta	Unmatched	0.07173	0.07691	-2.0		-1.01	0.312
	Matched	0.07175	0.07168	0.0	98.6	0.02	0.985
Urban	Unmatched	0.67914	0.79759	-27.2		-15.13	0.000
	Matched	0.67938	0.67881	0.1	99.5	0.07	0.941
HCM city	Unmatched	0.22488	0.30386	-18.0		-8.97	0.000
	Matched	0.22496	0.21860	1.4	92.0	1.58	0.114
Hanoi	Unmatched	0.11954	0.25754	-35.8		-16.63	0.000
	Matched	0.11958	0.12539	-1.5	95.8	-1.87	0.062

Source: Estimation from ECs 2005 and 2006

Table A.5. The impact of the minimum wage increase on profit margin – 1 nearest neighbor matching

Control group	Before the minimum wage increase			After the minimum wage increase			Diff-in-diff
	Y1	Y0	Y1-Y0	Y1	Y0	Y1-Y0	
	(1)	(2)	(3)=(1)-(2)	(4)	(5)	(6)=(1)-(2)	(7)=(6)-(3)
Control group having monthly wage above 350 thousand VND	0.02121***	0.02056***	0.00065	0.02305***	0.02279***	0.00026	-0.00039
	[0.00078]	[0.00154]	[0.00118]	[0.00075]	[0.00124]	[0.00134]	[0.00141]
Control group having monthly wage above 600 thousand VND	0.02121***	0.02052***	0.00069	0.02305***	0.02256***	0.00049	-0.00021
	[0.00078]	[0.00154]	[0.00117]	[0.00075]	[0.00120]	[0.00134]	[0.00138]
Control group having monthly wage above 800 thousand VND	0.02121***	0.02046***	0.00075	0.02305***	0.02283***	0.00022	-0.00053
	[0.00078]	[0.00149]	[0.00114]	[0.00075]	[0.00130]	[0.00146]	[0.00145]
Control group having monthly wage above 1000 thousand VND	0.02121***	0.01975***	0.00147	0.02305***	0.02205***	0.00099	-0.00047
	[0.00078]	[0.00148]	[0.00123]	[0.00075]	[0.00128]	[0.00142]	[0.00153]
Control group having monthly wage above 1200 thousand VND	0.02121***	0.01936***	0.00186	0.02305***	0.02164***	0.00140	-0.00045
	[0.00078]	[0.00147]	[0.00124]	[0.00075]	[0.00143]	[0.00157]	[0.00165]

* significant at 10%; ** significant at 5%; *** significant at 1%.
Standard errors in bracket (Standard errors are calculated using bootstrap with 500 replications).
Source: Estimation from ECs 2005 and 2006

Table A.6. The impact of the minimum wage increase on profit margin – 5 nearest neighbor matching

Control group	Before the minimum wage increase			After the minimum wage increase			Diff-in-diff
	Y1	Y0	Y1-Y0	Y1	Y0	Y1-Y0	
	(1)	(2)	(3)=(1)-(2)	(4)	(5)	(6)=(1)-(2)	(7)=(6)-(3)
Control group having monthly wage above 350 thousand VND	0.02121***	0.02062***	0.00060	0.02305***	0.02282***	0.00023	-0.00037
	[0.00078]	[0.00137]	[0.00091]	[0.00075]	[0.00103]	[0.00117]	[0.00120]
Control group having monthly wage above 600 thousand VND	0.02121***	0.02059***	0.00062	0.02305***	0.02261***	0.00044	-0.00018
	[0.00078]	[0.00134]	[0.00090]	[0.00075]	[0.00101]	[0.00119]	[0.00116]
Control group having monthly wage above 800 thousand VND	0.02121***	0.02042***	0.00079	0.02305***	0.02278***	0.00026	-0.00052
	[0.00078]	[0.00132]	[0.00090]	[0.00075]	[0.00106]	[0.00124]	[0.00123]
Control group having monthly wage above 1000 thousand VND	0.02121***	0.01978***	0.00143	0.02305***	0.02219***	0.00086	-0.00057
	[0.00078]	[0.00126]	[0.00098]	[0.00075]	[0.00109]	[0.00125]	[0.00137]
Control group having monthly wage above 1200 thousand VND	0.02121***	0.01932***	0.00189	0.02305***	0.02173***	0.00131	-0.00058
	[0.00078]	[0.00130]	[0.00106]	[0.00075]	[0.00134]	[0.00150]	[0.00152]

* significant at 10%; ** significant at 5%; *** significant at 1%.
Standard errors in bracket (Standard errors are calculated using bootstrap with 500 replications).
Source: Estimation from ECs 2005 and 2006

Table A.7: Sample description

Type of firms	Freq.	Percent	Number of workers in 2005	Number of workers in 2006	Revenue in 2005 (million VND)	Revenue in 2006 (million VND)	Profit margin in 2005	Profit margin in 2006
Firms in 2005 but not in 2006	15,709	10.69	46.0	na.	17177	na.	0.024	na.
Firms in 2006 but not in 2005	33,998	23.13	na.	22.9	na.	10476	na.	0.024
Firms in both 2005 and 2006	97,306	66.19	56.8	59.1	20404	24501	0.029	0.033

na. means 'not available', since there is no data.
Source: Estimation from ECs 2005 and 2006

Appendix 2: Propensity score matching estimators

In the matching estimator (equation 4):

$$A\hat{T}T = \sum_{i \in Treatment} \left[\Delta y_i - \sum_{j \in Control} g(\hat{p}_i, \hat{p}_j) \Delta y_j \right],$$

The weights are defined non-negative and sum up to 1, i.e.: $\sum_{j \in Control} g(\hat{p}_i, \hat{p}_j) = 1$.

If each participant is matched with the one non-participant with the minimum value of *d(i,j)* (where *d(i,j)* is the distance between the propensity scores of participant *i* and that of non-participant *j*), the weight $g(\hat{p}_i, \hat{p}_j)$ equals 1 for all pairs of matches. This is called one nearest neighbor matching. When more than one non-participants are matched with each participant (or vice versa), we need some ways to define the weights attached to each non-participant.

A number of methods use equal weights for all matches. N-nearest neighbors matching involves matching each participant with n non-participants whose have the closest propensity scores. Each matched non-participant will receive weight $g(\hat{p}_i, \hat{p}_j) = 1/n$.[4] However, it could be reasonable to assign different weights to different non-participants depending on metric distances between their covariates and the covariates of the matched participant (see, e.g., Heckman, et al., 1997; Smith and Todd, 2005). The kernel matching method matches a participant with one or many non-participants depending a kernel function and a selected bandwidth h. The kernel functions for kernel is the Epanechnikov (default in psmatch2).

[4] Caliper matching (see, e.g., Dehejia and Wahba, 1998; Smith and Todd, 2005) uses equal weights for matched subjects whose distance *d(i,j)* is smaller than a specific value, say 0.05 or 0.1. This criterion aims to ensure the quality of matching. Stratification (interval) matching divides the range of estimated distances into several strata (blocks) of equal ranges. Within each stratum, a participant is matched with all non-participants with equal weights (see, e.g., Dehejia and Wahba, 1998); Smith and Todd, 2005).