Do Minimum Wage Increases Cause Inflation? Evidence from Vietnam

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20 March 2011

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Abstract

It is often argued that minimum wage increases can lead to increased inflation. This paper examines the impact of minimum wage increases on inflation in Vietnam during the 1994-2008 period. Inflation is measured by a monthly overall Consumer Price Index (CPI) and a monthly food CPI. It is found that the minimum wage increases did not increase inflation. Since the minimum wage increases often took place one or two months before the Vietnamese New Year festivals, observed increases in monthly inflation after the minimum wage increases were caused by increased consumption demand during the New Year festivals, not by the minimum wage increases.

Keywords: Minimum wages, inflation, CPI, Vietnam.

JEL classification: J30; E31; J38.

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I. Introduction

Minimum wages are the lowest hourly, daily or monthly wage that a government requires employers to pay to employees. The main argument for minimum wages is to increase the living standards of laborers, especially the poor. In addition, minimum wage increases can have other positive effects such as promoting labors' work effort and productivity, reducing people covered in subsidy programs, increasing consumption, aggregate demand and generation of multiplier effects (Freeman, 1994; Dowrick and Quiggin, 2003; Gunderson, 2005).

However, minimum wage increases can lead to negative impacts. In the traditional economic theory, firms will respond to an increase in labor cost by reducing demand for labor or increasing the output prices (Hamermesh, 1986; Brown, 1999). As a result, unemployment and inflation can be increased. Poor laborers, whom governments aim to protect by minimum wages, can be hurt by minimum wage increases.

Although minimum wage increases are expected to increase prices, the magnitude of price increase depends on several factors such as the demand elasticity and competition degree (Aaronson, 2001). A strong effect of minimum wages on inflation is not always found in empirical studies. Several studies, e.g., Card and Krueger (1995), Aaronson (2001), Macdonald and Arasonson (2000), found that a 10% minimum wage increase leads to around 1-4% increases in prices. However, other studies such as Frye and Gordon (1981), Sellekaerts (1981), Katz and Krueger (1992), Card and Krueger (1995) found very small or not statistically significant effects of minimum wage increases on prices. Detailed review of studies on the effect of minimum wages on prices can be found in Lemos (2004).

Vietnam has committed itself to a "growth with equity" strategy of development. The country has achieved high economic growth, with an average annual GDP growth rate of around 6% over the past 10 years. The poverty rate declined remarkably from 58% to 16% between 1993 and 2006 (World Bank, 2008). To increase living standards of laborers, especially the low-wage ones, the government of Vietnam has a policy of minimum wage increases on a regular basis. There have been 9 adjustments of the

minimum wage since the year 1993. The real minimum wage increased by around 118% during the period 1994-2008. However, minimum wage increases lead to on-going debates about the impacts on inflation in Vietnam. A large number of advocates of the minimum wages including the government argue that reasonable minimum wage increases do not cause high inflation. Instead, increased minimum wages can lead to an increase in consumption, aggregate demand and economic growth, especially in the context of economic slowdown (e.g., see Dan Tri, 2009a; Duy Tuan, 2009). On the contrary, minimum wage increases are blamed for increased prices (Vneconomy, 2003; Dan Tri, 2009b; Bao Moi, 2009). Especially, there was an increase in the minimum wage in early 2008, then followed by very high inflation in mid-2008. Certainly, high inflation reduces real minimum wages and can decrease the efficiency of the economy.

The arguments on the impact of minimum wage increases on inflation in Vietnam are often made without empirical evidence on impact evaluation of minimum wage increases. Thus, this paper aims to measure the impact of minimum wage increases on inflation in Vietnam. Inflation is measured by the monthly overall Consumer Price Index (CPI) and the monthly food CPI. If a positive impact of the minimum wage increases on inflation is found, the government should reconsider the policy on minimum wage increases or have price-adjusting policies accompanied with minimum wage increases.

The paper is structured into five sections. The second section describes the minimum wage adjustments and inflation in Vietnam. The third section presents the methodology to measure the impact of minimum wage increases on inflation. Next, empirical results on the impact are presented in the fourth section. The fifth section concludes.

II. Minimum Wages and Inflation in Vietnam

II.1. Data Sources

In this study, inflation is measured by the monthly Consumer Price Index (CPI) from January 1994 to December 2008. We use both overall and food CPIs as measures of monthly overall and food inflation, respectively. The CPI data are calculated by the Department of Trade and Price, General Statistical Office of Vietnam (GSO). In addition, the paper uses data on monthly changes in the average exchange rate (in terms of the US dollar) and yearly indicators of the Vietnamese economy such as GDP, population, money supply, and state revenue.

II.2. Minimum Wages

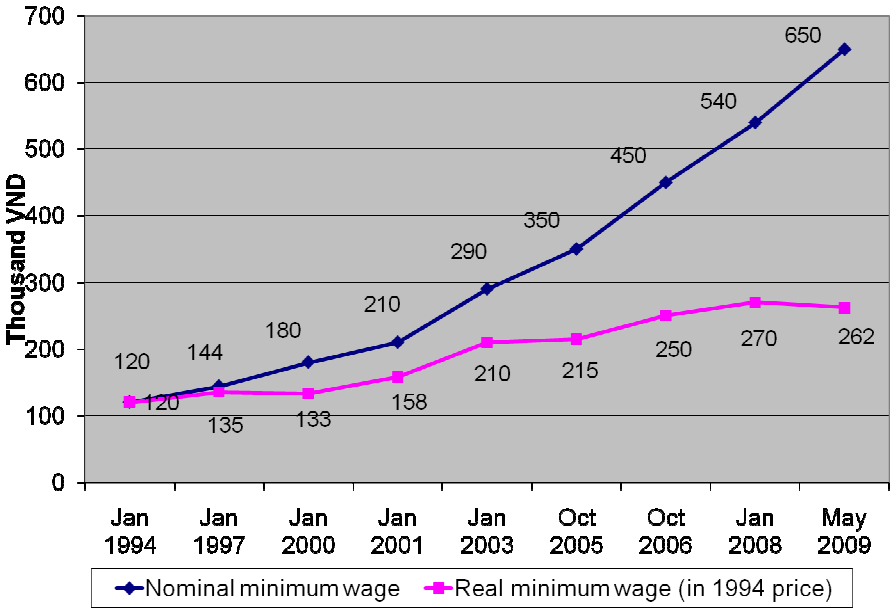
In Vietnam, the minimum wage is defined as the lowest monthly wage for a simple worker in normal working conditions (Vu Thieu, 2006). The minimum wage is required to ensure the basic needs of the laborers and dependants in their family. Economic growth and price inflation require the adjustment of minimum wages. The Labor Law of Vietnam also stipulates that the government must adjust the minimum wage when there is a change in prices of commodities and services. In addition, minimum wage adjustments are also based on payment capacity of the State budget, since all the wage of all workers in the State sector are tied to the level of the minimum wage.

Since the year 1993, there have been 9 adjustments of the minimum monthly wage in Vietnam. All of these adjustments are increases in the minimum wage. It should be noted that Vietnam has only minimum monthly wage, not minimum daily or hourly wage. The timing and the level of the minimum wage after adjustment are presented in Figure 1. In addition to the nominal minimum wages, the figure also presents the real minimum wages in terms of the 1994 price (deflated by the CPI). It shows that the nominal minimum wage increased by 442% from 120 to 650 thousand VND during the period 1994-2009. However, the real minimum wage just increased by 118% from 120 to 262 thousand VND. The annual growth rate of real minimum wages is estimated at around 5% which is lower than the average annual GDP growth rate of 7.5%. In the most recent minimum wage adjustment in May 2009, although the nominal minimum wage

was increased by 20% from 540 to 650 thousand VND, the real one was reduced from 270 to 262 thousand VND due to high inflation in 2008.

FIGURE 1

Minimum Monthly Wage in Vietnam (thousand VND)



Source: CPI data from General Statistical Office of Vietnam

There are two points on minimum wages that should be noted. Firstly, the minimum wages presented in Figure 1 are applied for the governmental sector and the domestic sector. Minimum wages applied for the foreign sector including foreign joint-venture enterprises, foreign-invested enterprises, international individuals, institutions and organizations are higher. Secondly, before 2008 there was only one domestic minimum wage throughout the country. From January 2008, there are different regional minimum wages for different regions.[2] Table 1 presents the regional minimum wage for the foreign and domestic sectors.

[2] For more details, see Government of Vietnam (2007), Government of Vietnam (2008a), Government of Vietnam (2008b).

TABLE 1

Regional Minimum Wages in Vietnam (thousand VND, nominal prices)

Regions	Years of minimum wage adjustment			
	1999	2006	2008	2009
Foreign sector				
Urban Ha Noi and Ho Chi Minh cities	626	790	1000	1200
Rural Hanoi and Ho Chi Minh cities, and several rich areas	556	710	900	1080; 950
Other areas	487	630	800	920
Domestic sector				
Urban Ha Noi and Ho Chi Minh cities			620	800
Rural Hanoi and Ho Chi Minh cities, and several rich areas			580	740; 690
Other areas (also for government sector)			540	650

II.3. Inflation Trend

As mentioned, inflation is measured by the monthly overall CPI and food CPI. In Vietnam, the monthly CPI is defined as an index that measures the percentage rate at which the prices of consumer goods and services are changing from month to month. The compilation of price statistics has conducted in Vietnam by the General Statistical Office since 1956. The CPI is constructed at three levels: provincial level, regional level and the whole country. At each level, the CPI index is estimated for rural and urban areas. The CPI is estimated using the Laspeyres formula.[3]

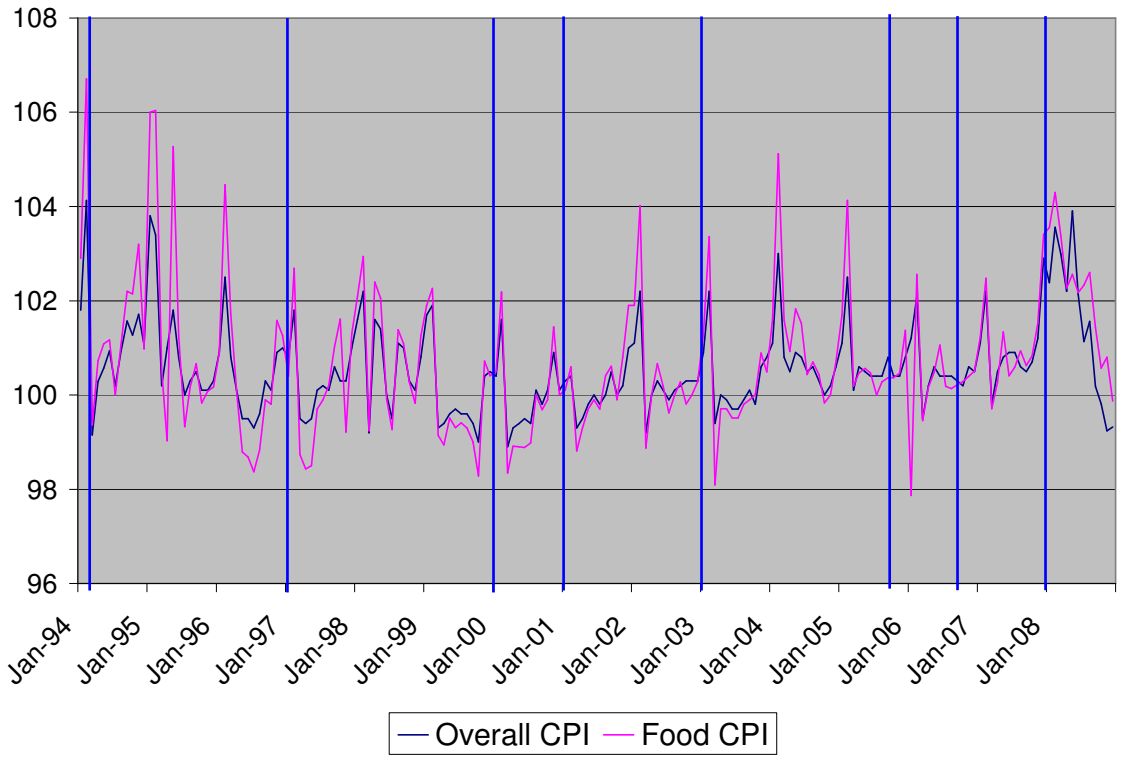
[3] the Laspeyres formula is expressed as follows:

$$P_L(p^0, p^1, q^0, q^1) = \frac{\sum_{i=1}^{n} p_i^1 q_i^0}{\sum_{i=1}^{n} p_i^0 q_i^0},$$

where p_i^0 and p_i^1 are the prices of item (good or service) i in the periods 0 and 1 (the base and current periods), respectively; and q_i^0 is the quantity of the item i in the base period.

FIGURE 2

Monthly CPI (%) during January 1994 – December 2008, and Months of Minimum Wage Increases



Source: Author's preparation using data from General Statistical Office of Vietnam

Among the consumption basket that is used to calculate the CPI, items of food account for a large proportion. However, as the living standard increases, the share of food in the consumption basket tends to go down. For example, the weight of food in the consumption basket decreased from 60.9% in 1995 to 47.9% in 2000.

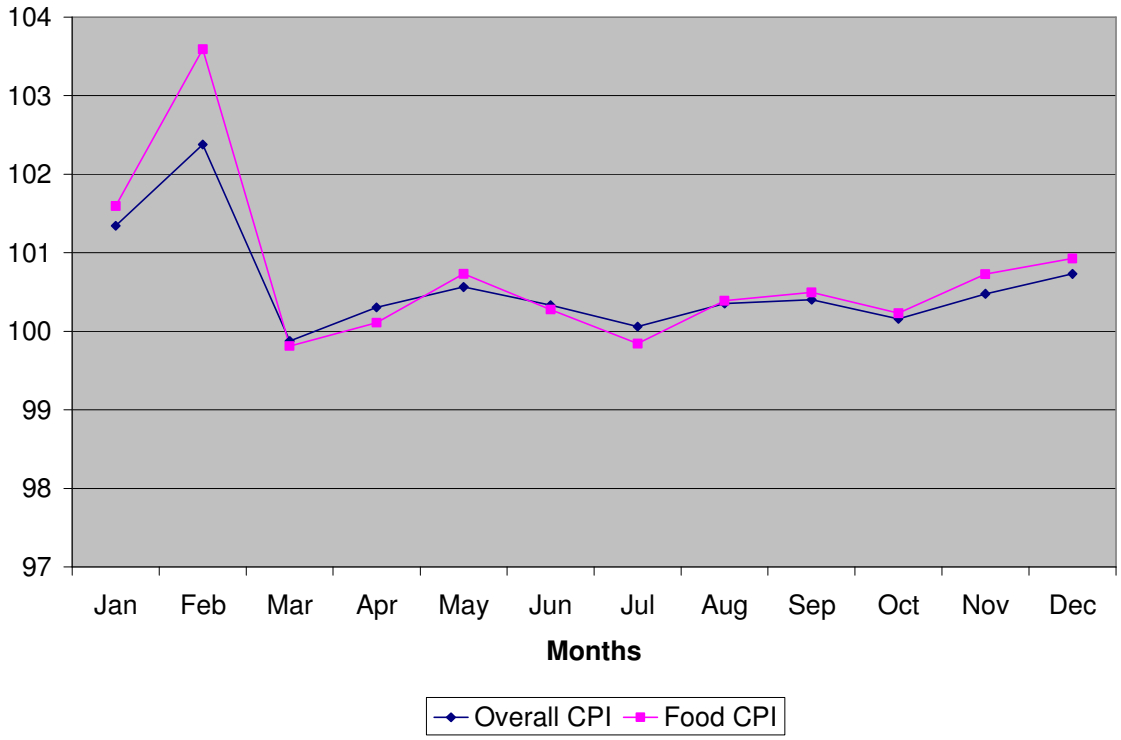
Figure 2 graphs the monthly overall CPI and the monthly food CPI, and the months with minimum wage increases (the vertical lines) during the period 1994-2008. Except for a few months, the CPIs often fluctuated between 98% and 106%. The overall CPI and the food CPI were quite close and had similar trend. This is because food accounts for nearly 50% of items in the overall consumption basket that is used to estimate the overall CPI. However, the food CPI had slightly larger fluctuation than the overall CPI during the period 1994-2008.

From Figure 2, it seems that the CPIs tend to increase after the minimum wage increases. However, since the minimum wage increases often take place in January, the time after the minimum wage increases often coincides with the New Year festival in Vietnam. As known, people tend to spend more on consumption and services during the New Year festival, and the prices are more likely to rise during this festival. After that the CPIs tend to decrease.

Figure 3 presents the average CPIs by months over the period 1994-2008. As expected, the overall CPI was highest in January and February, at 101.3% and 102.4%, respectively. The food CPI was 101.6% and 103.6% in January and February, respectively. After the New Year festivals, both the overall and food CPIs decreased to the lowest level, at around 99.9% in March.

FIGURE 3

Monthly CPI Averaged by Months during 1994 – 2008 (%)

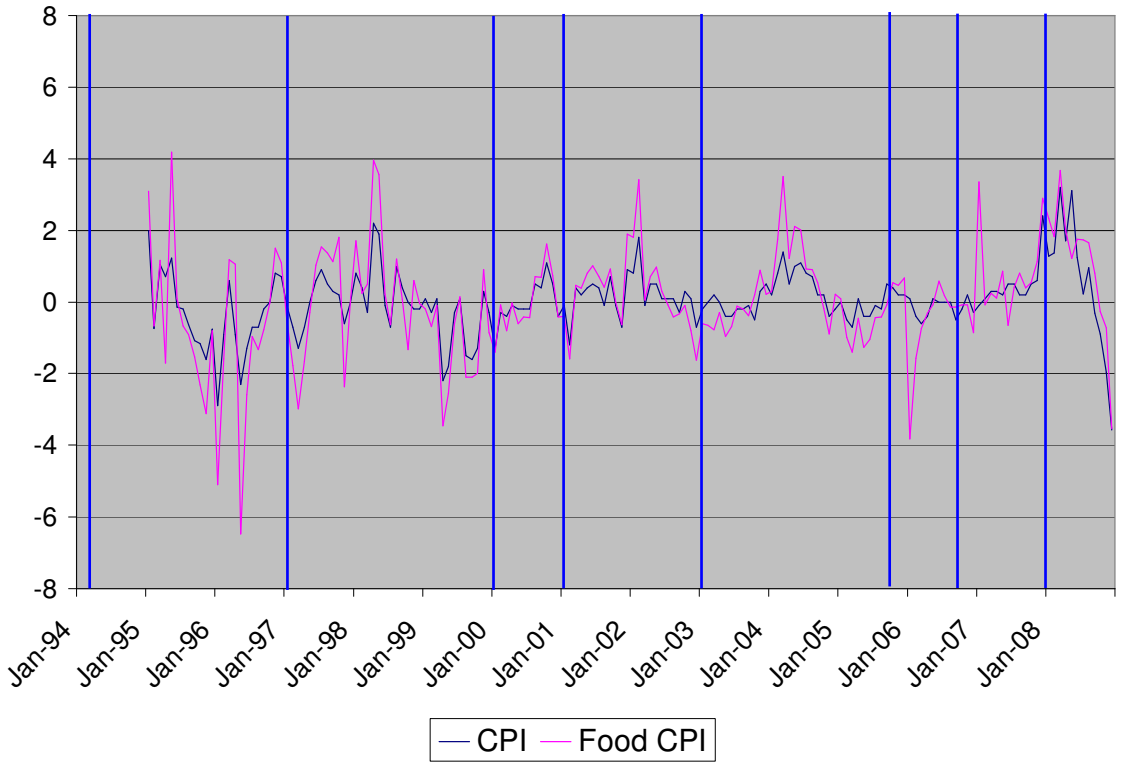


Source: Author's preparation using data from General Statistical Office of Vietnam

Since the CPIs seem to have a seasonal trend, we calculate the seasonal difference of the CPIs with the seasonal period of 12 months. Figure 4 presents these seasonal differences of the monthly overall CPI and food CPI, and the months with minimum wage increases (the vertical lines) during the period 1994-2008. Now, there is no clear evidence that the monthly CPIs increase after the minimum wage increases.

FIGURE 4

Seasonal Differences in Monthly CPI (%) During January 1994 – December 2008, and Months of Minimum Wage Increases



Source: Author's preparation using data from General Statistical Office of Vietnam

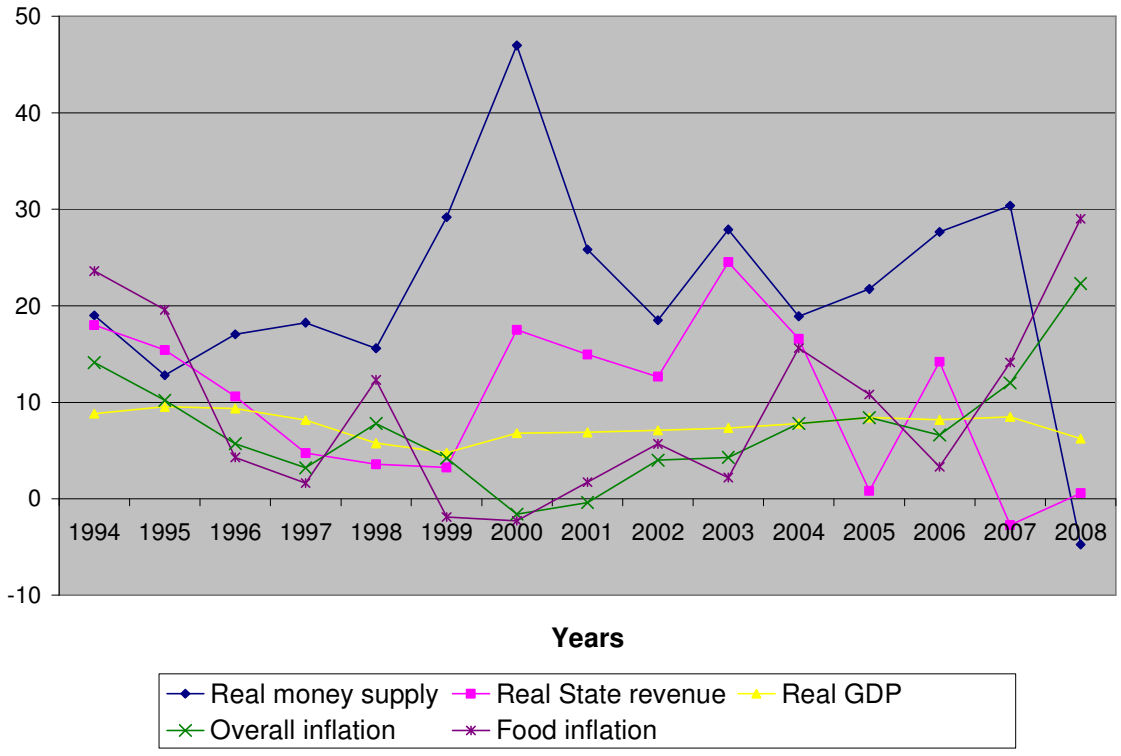
Figure 5 examines the annual inflation rate and annual growth rate of several economic indicators during the period 1994-2008. In general, there is no clear relation between inflation and other economic indictors. As can be seen, the inflation rate was below 10% during the period 1996-2006. There was deflation in years 2000 and 2001. However, inflation was very high in 2007 and 2008, at 13% and 22%, respectively. Food inflation was even higher, at 14% and 29% in 2007 and 2008, respectively. To control

inflation, the government doubled the interest rate of commercial banks to reduce the money supply in 2008. As a result, the real money supply was reduced by nearly 5% in 2008. Because of high inflation, the growth of real State revenue was negative in 2007 and barely positive in 2008.

Figure 5 also shows that the growth of real money supply was much higher than the growth of real GDP. The government increased the money supply mainly by printing more money. Although increased money supply is often blamed for high inflation in Vietnam (especially by mass-media e.g. Nguyen, 2007; Minh, 2008), there is not a strong correlation between money supply and inflation. For example, the money supply was very high during 1998-2000, but the inflation rate was very low during this period.

FIGURE 5

Annual Growth of Several Economic Indicators (%)



Source: Author's preparation using data from General Statistical Office of Vietnam

III. Method of Impact Estimation

There is large literature on inflation. In economic textbooks, determinants of inflation can be increases in input costs and demands, and excess in money supply (Mankiw, 2000). Any gap between aggregate demand and aggregate supply of an economy can lead to inflation. In the cost-push theory inflation, higher production cost can result in a higher price. For the whole economy, demand is less elastic and supply reduction can lead to excess demand and increased price (Castle, 2003). The demand-pull inflation theory argues that inflation can happen if demand is much higher than supply. According to monetarists, inflation is essentially a monetary phenomenon (Friedman, 1963). If the aggregate demand and supply are unchanged, an additional increase in the money supply can cause inflation. So all variables which can increase aggregate demand, supply and the money supply substantially can cause inflation. In addition, the theory of adaptive expectation inflation assumes that people's expectation of future inflation which depends on current inflation can also affect inflation. It means that the current inflation can depend on the past inflation (Mankiw, 2000).

In our study, a minimum wage increase can be regarded as an increase in industry-wide costs which can result in higher inflation. Empirical studies try to model the determinants of inflation in both developed and developing countries (e.g., Fahrer and Myatt, 1991; Adedeji and Liu, 2005; Feridun and Okhari, 2006; Adedeji and William, 2004). To estimate the impact of the minimum wage increases in Vietnam, we rely on time-series regressions of the monthly CPIs on variables indicating minimum wages increases and other explanatory variables as follows:[4]

$$y_t = \beta_0 + \left(y_{t-1}\beta_1^y + \ldots y_{t-g}\beta_g^y\right) + \left(D_{t+k}\beta_{t+k}^D + \ldots + D_{t+1}\beta_{t+1}^D + D_t\beta_t^D + D_{t-1}\beta_{t-1}^D + \ldots + D_{t-k}\beta_{t-k}^D\right) + X_t\beta_X + M_t\beta_M + \varepsilon_t, \quad (1)$$

[4] An advantage of regression method using national time-series data is that it accounts for all steps through which minimum wage increases impact inflation. In other words, both direct and indirect effects of the minimum wage increased are included in the regressions (Lemos, 2004).

where y_t is dependent variable, i.e., the monthly overall CPI and food CPI, at time t, y_{t-g} is g-lagged dependent variable; D_t is the dummy variables indicating months when there are minimum wage increases; D_{t-k} are lagged variables; and D_{t+k} are leaded variables; X is a vector of control variables; M is a vector of dummy variables indicating months; and ε_t are unobserved variables. We control lagged CPIs as explanatory variables since, as mentioned, the current inflation can depend on the past inflation.

The reason for using the lagged and leaded variables is that the minimum wage increases can have leaded or lagged effects on the CPIs, i.e., the CPIs can be changed before and after the time of the minimum wage increases. It is possible that people predict an increase in prices due to an increase in the minimum wage and they can increase consumption before the minimum wage increase to avoid rising prices. It means that increased minimum wages might have leaded effects on the CPIs.

The short-run effect is measured by $\hat{\beta}_t^D$, and the long-run effect is estimated by $\left(\hat{\beta}_{t+k}^D + ... + \hat{\beta}_{t+1}^D + \hat{\beta}_t^D + \hat{\beta}_{t-1}^D + ... + \hat{\beta}_{t-k}^D\right)$.

Similar to empirical studies on the determinants of inflation (e.g., Fahrer and Myatt, 1991; Adedeji and Liu, 2005; Feridun and Okhari, 2006; Adedeji and William, 2004), other independent variables, X_t, are included in equation (1) to mitigate of the endogeneity problem. If the minimum wage increases are correlated with unobserved variables, estimation of the minimum wage increases will be biased (e.g., see Moffitt, 1999, and Wooldridge, 2002). We should control all variables which affect both the minimum wage increases and the CPIs. It is said that the government of Vietnam often consider economic growth, past inflation, and State budget when deciding minimum wage increases (Tran, et al., 2006). The proxies for these factors are annual growth of real GDP, inflation rate in the last period, and annual growth of real State budget. Since inflation can depend on the quantity of money, we also control annual growth of real money supply (M1). This is an important variable, and ideally monthly or quarterly data on money supple are available. However, in this study we only have data on annual money supply.

The monthly price index of US dollar is also included. Dummy variables indicating months are controlled to correct seasonality of the CPIs. It should be noted that

all of these explanatory variables can be proxies for determinants of inflation such as cost-push and demand-pull factors, money excess and past inflation.

A problem in the variable of minimum wage increases is that there are only 8 months with minimum wage increases. It means that we have a small number of observations with minimum wage increases. In addition to the definition of minimum wage variable in equation (1), we also define the minimum wage variable as several months around the month when the minimum wage increases take place. More specifically, three additional minimum wage variables are defined as follows: the first is a dummy variable indicating duration between the month with minimum wage increases and two months later; the second is a dummy variable indicating duration between the month with minimum wage increases and seven months later; the third is a dummy variable indicating a two-month window around the month with minimum wage increases. In other words, these defined variables are used to measure long-run impact of minimum wage increases on the average CPI of several months. The new variables denoting minimum wage increases are also binary, but these variables have more observations with value equal to one. Equation (1) becomes:

$$y_t = \beta_0 + \left(y_{t-1}\beta_1^y + \ldots y_{t-g}\beta_g^y\right) + D_t\beta_D + X_t\beta_X + M_t\beta_M + \varepsilon_t, \qquad (2)$$

where D_t is the variable indicating a window of months around that date of the minimum wage increases. There is no lag or lead variable of D_t.

IV. Empirical Results

This section discusses the results from regressions of the overall CPI and food CPI on minimum wage increases and control variables. Before running regression of the CPIs, we test whether the CPIs follow a unit-root process. If the CPIs follow a unit-root or non-stationary process, asymptotic tests of the standard regressions can not be used. Table A.1 in Appendix presents results from the Dickey – Fuller tests. The tests show the hypothesis on unit-root process of the CPIs is strongly rejected.

The regressions of overall CPI are presented in Tables A.2 and A.4, and regressions of the food CPI are presented in Tables A.5 and A.6. To examine the sensitivity of the impact estimates, we used different regression models with different set of minimum wage variables and control variables. In Model 1, 2, and 3, we run Feasible Generalized Least Squares (FGLS) regressions in which the errors are assumed to follow a first-order autoregressive, $\varepsilon_t = \rho\varepsilon_{t-1} + u_t$, with ρ estimated by OLS regression. We do not run Ordinary Least Squares (OLS) regressions for Models 1, 2, and 3, since tests of autocorrelation (the Durbin's alternative test and the Breusch-Godfrey test) strongly reject the hypothesis of no first-order autocorrelation of the error term. In Models from 4 to 9, we include the lagged variables of CPIs to reflect the theory of adaptive expectation inflation. The number of lagged variables varies across different models. In addition, once the lagged variables of CPIs are controlled, the hypothesis of no autocorrelation of the error term is not rejected.

Table A.2 shows that the overall CPI or overall inflation decreased in the months with minimum wage increases. The CPI tended to decrease by about 0.4 percentage points in these months. However, the estimates are only statistically significant at the 10% level in some models. The lag effects of the minimum wage increases on the CPI are not statistically significant. Estimates of the long-run effects are quite small and not statistically significant.

The negative sign of the minimum wage increases is difficult to interpret. A possible story to explain this negative sign is that people predict an increase in prices due to minimum wage increases, and this prediction can cause inflation before the minimum wage increases actually occurs. When the higher minimum wages come into effect, though, people find that prices have not risen as much as they expect, so they moderate their own prices.

Multicollinearity arises when explanatory variables are highly correlated with each other. Multicollinearity does not affect the unbiasedness of estimators but it can increase the standard error of estimators. In our models, there are lagged and lead variables which can be correlated. To test multicollinearity, we compute the variance

inflation factor (VIF) of explanatory variables.[5] As a rule of thumb, a variable having VIF greater than 10 indicates high collinearity between this variable and other explanatory variables. Table A.3 in Appendix presents estimates of VIF in large models (Models 6 to 9). It shows that the VIF average of the explanatory variables is quite small, around 2 to 3. No variable has a VIF value above 5. It means a low multicollinearity among explanatory variables in our models.

As mentioned in section 3, we use also variables of duration around the minimum wage increases in the regressions. Table A.4 shows that the variables of minimum wage increases are very small and not statistically significant.

In these regressions, control variables have expected signs. For example, the previous month CPI is positively correlated with the current-month CPI. The CPI is highest in January and February. As mentioned, Vietnamese New Year festival often takes place in these months, and prices are increased since people tend to increase consumption in the festival. Other economic indicators such as growth of GDP, money supply and State revenue have positive coefficients, but the coefficients are not statistically significant. This can be because the annual indicators can not capture the fluctuation of monthly prices. As mentioned, ideally, we should use monthly or quarterly explanatory variables. However, data on these variables are not available in Vietnam.

Similarly, evidence of increased food CPI is not found. Table A.5 shows that the food CPI decreased by around 0.2 percentage points in the month with minimum wage increases. The long-run effects of minimum wage increases on the food CPI are also negative. However, these estimates are not statistically significant. Table A.6 also shows similar trend of effects on the food CPI. The point estimates of effect are negative, but not statistically significant.

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[5] The variance inflation factor is calculated as follows:

$$VIF_j = \frac{1}{1 - R_j^2} \quad (j = 1, 2, \ldots k)$$

where R_j^2 is the R-squared of the regression of the i-th explanatory variable on the remaining explanatory variables. We can also use Tolerance, defined as 1/VIF, to check on the degree of collinearity. A tolerance value below than 0.1 is comparable to a VIF of 10.

V. Conclusions

It is often argued that minimum wage increases can lead to increased inflation. In Vietnam, there have been 9 increases of the minimum wage since the year 1993. The real minimum wage increased by around 118% during the period 1994-2009. The CPI increased by 245% during this period. Increased minimum wages are sometimes to blame for an increase in the prices of commodities and services in Vietnam. Yet, there has been no quantitative analysis of the impact of minimum wage increases on inflation in Vietnam. This paper is the first attempt to examine the impact of the minimum wage increases on inflation during the period 1994-2008 using OLS regressions. Inflation is measured by the monthly overall CPI and monthly food CPI. It is found that the minimum wage increases did not increase the overall and food CPIs. Instead, the point estimates of both short-run and long-run effects of the minimum wage increases on these CPIs are negative. However, these estimates are not statistically significant at the 5% level. It should be noted that the minimum wage increases often took place one or two months before the Vietnamese New Year festivals. Thus, observed increases in monthly inflation after the minimum wage increases resulted from increased consumption demand during the New Year festivals, not from the minimum wage increases.

There are two possible explanations for insignificant impacts of minimum wage increases on inflation. Firstly, the number of laborers who are affected by minimum wage increases might be small. According to Nguyen (2009), there are around 10% of workers who have low-wage and can be affected by minimum wage increases. In addition, around 60% of laborers are self-employed and working for other households. These groups are not influenced by minimum wage increases. Secondly, the number of enterprises affected by minimum wage increases, and under market competition these enterprises are unable to pass through to prices the higher costs due minimum wage increases. It implies that the production unit cost as well as the aggregate demand is not increased. As a result, there are no significant impacts of minimum wage increases on inflation. Analysis of channels through which the minimum wage increases impinge on inflation requires different data

sets such as enterprise surveys and household surveys, thus it is beyond the scope of the paper, but certainly important for future research.

There are two main policy implications for Vietnam deriving from this study. Firstly, the minimum wages should be increased to compensate wage workers for real-wage reduction caused by inflation in Vietnam. The annual growth rate of real minimum wages is still lower than that of GDP. In the most recent increase of the minimum wage in May 2009, although the nominal minimum wage increased by 20%, the real one decreased by 3% (due to high inflation in 2008). Secondly, previous increases in minimum wages are found not to lead to high inflation. So a reasonable increase in minimum wages is a result of inflation, not a cause of inflation.

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APPENDIX

TABLE A.1 Dickey – Fuller tests of unit root of overall and food CPIs

	Overall CPI: ΔD (Difference $CPI_t - CPI_{t-1}$)			Food CPI: ΔD (Difference $CPI_t - CPI_{t-1}$)		
Explanatory variables	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
CPI_1 (one-period lag of CPI)	-0.540***	-0.545***	-0.397***	-0.640***	-0.641***	-0.456***
	[0.067]	[0.067]	[0.090]	[0.070]	[0.070]	[0.100]
ΔCPI_1 (one-period lag of ΔCPI)			-0.152			-0.206**
			[0.096]			[0.101]
ΔCPI_2 (two-period lag of ΔCPI)			-0.124			-0.205**
			[0.083]			[0.086]
ΔCPI_3 (three-period lag of ΔCPI)			0.017			-0.048
			[0.072]			[0.072]
Trend		0.001	0.001		0.001	0.001
		[0.001]	[0.001]		[0.002]	[0.002]
Constant	54.350***	54.709***	39.831***	64.442***	64.468***	45.752***
	[6.718]	[6.745]	[9.006]	[7.026]	[7.042]	[10.013]
Z(t)	-8.092	-8.114	-4.421	-9.175	-9.164	-4.575
MacKinnon approximate p-value	0.000	0.000	0.002	0.000	0.000	0.001
Number of observations	179	179	176	179	179	176

Robust standard errors in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%
Source: Author's estimation

TABLE A.2 Regression of monthly overall CPI

Explanatory variables	Model 1 (FGLS)	Model 2 (FGLS)	Model 3 (FGLS)	Model 4 (OLS)	Model 5 (OLS)	Model 6 (OLS)	Model 7 (OLS)	Model 8 (OLS)	Model 9 (OLS)
D (Dummy variable indicating month with minimum wage increase)	-0.296	-0.282	-0.407*	-0.432*	-0.4	-0.470*	-0.442*	-0.423*	-0.405*
	[0.286]	[0.205]	[0.226]	[0.238]	[0.244]	[0.244]	[0.251]	[0.235]	[0.238]
D_1 (one-period lag of D)			-0.346	-0.199	-0.171	-0.171	-0.146	-0.22	-0.212
			[0.254]	[0.240]	[0.247]	[0.247]	[0.254]	[0.239]	[0.245]
D_2 (two-period lag of D)			0.141	0.263	0.239	0.253	0.239	0.245	0.193
			[0.219]	[0.240]	[0.248]	[0.247]	[0.255]	[0.240]	[0.247]
D_3 (three-period lag of D)						-0.298	-0.295		
						[0.249]	[0.262]		
D_4 (fourth-period lag of D)						0.125	0.121		
						[0.250]	[0.263]		
D_5 (five-period lag of D)						0.002	0.004		
						[0.246]	[0.256]		
D_6 (six-period lag of D)						0.085	0.088		
						[0.245]	[0.256]		
D_7 (seven-period lag of D)						0.157	0.111		
						[0.235]	[0.255]		
D1 (one-period lead of D)								0.176	0.215
								[0.238]	[0.253]
D2 (two-period lead of D)								0.246	0.319
								[0.238]	[0.245]
CPI_1 (one-period lag of CPI)				0.587***	0.583***	0.610***	0.596***	0.550***	0.510***
				[0.076]	[0.083]	[0.081]	[0.085]	[0.076]	[0.085]
CPI_2 (two-period lag of CPI)				0.097	0.054	0.054	0.038	0.088	0.03
				[0.084]	[0.095]	[0.095]	[0.099]	[0.083]	[0.094]
CPI_3 (three-period lag of CPI)				0.118	0.128	0.142*	0.131	0.167**	0.170**
				[0.075]	[0.085]	[0.082]	[0.088]	[0.076]	[0.085]
January		0.629***	0.665***	0.547**	0.508**	0.617***	0.568**	0.587**	0.588**
		[0.180]	[0.172]	[0.219]	[0.232]	[0.228]	[0.240]	[0.238]	[0.258]
February		1.572***	1.594***	1.053***	1.025***	1.030***	0.999***	1.105***	1.142***
		[0.208]	[0.214]	[0.224]	[0.239]	[0.232]	[0.249]	[0.242]	[0.266]
March		-0.917***	-0.908***	-2.069***	-2.058***	-2.068***	-2.064***	-1.992***	-1.867***
		[0.232]	[0.228]	[0.232]	[0.256]	[0.242]	[0.268]	[0.246]	[0.278]
April		-0.477*	-0.412*	-0.364	-0.349	-0.203	-0.218	-0.397	-0.344
		[0.246]	[0.238]	[0.277]	[0.294]	[0.311]	[0.330]	[0.290]	[0.308]

Explanatory variables	Model 1 (FGLS)	Model 2 (FGLS)	Model 3 (FGLS)	Model 4 (OLS)	Model 5 (OLS)	Model 6 (OLS)	Model 7 (OLS)	Model 8 (OLS)	Model 9 (OLS)
May		-0.21	-0.147	-0.237	-0.308	-0.347	-0.373	-0.327	-0.369
		[0.253]	[0.245]	[0.257]	[0.275]	[0.290]	[0.310]	[0.270]	[0.290]
June		-0.438*	-0.376	-0.369*	-0.455**	-0.405*	-0.454*	-0.323	-0.397
		[0.255]	[0.247]	[0.200]	[0.213]	[0.224]	[0.235]	[0.222]	[0.243]
July		-0.704***	-0.644***	-0.579***	-0.594***	-0.570**	-0.616**	-0.560**	-0.562**
		[0.253]	[0.244]	[0.200]	[0.215]	[0.225]	[0.236]	[0.220]	[0.242]
August		-0.408*	-0.351	-0.136	-0.216	-0.187	-0.248	-0.176	-0.261
		[0.245]	[0.236]	[0.200]	[0.215]	[0.225]	[0.235]	[0.222]	[0.243]
September		-0.352	-0.301	-0.203	-0.308	-0.204	-0.308	-0.213	-0.321
		[0.230]	[0.221]	[0.196]	[0.209]	[0.199]	[0.211]	[0.205]	[0.222]
October		-0.554***	-0.493**	-0.416**	-0.482**	-0.394*	-0.470**	-0.386*	-0.441*
		[0.206]	[0.197]	[0.201]	[0.215]	[0.204]	[0.218]	[0.221]	[0.244]
November		-0.266*	-0.186	-0.025	-0.097	-0.011	-0.093	-0.012	-0.097
		[0.159]	[0.152]	[0.201]	[0.214]	[0.205]	[0.216]	[0.243]	[0.263]
December		Base-omitted							
One-period lag of growth of annual State revenue					0.004		0.004		0
					[0.006]		[0.007]		[0.006]
One-period lag of growth of annual GDP					0.036		0.036		0.059
					[0.041]		[0.043]		[0.041]
One-period lag of growth of annual money supply (M1)					0.003		0.003		0.009
					[0.006]		[0.007]		[0.007]
One period lag of annual average CPI					0.004		0.004		0.013
					[0.015]		[0.015]		[0.015]
Month change in exchange rate (price index of US dollar)					-0.004		-0.004		0.011
					[0.027]		[0.028]		[0.028]
Constant	100.597***	100.763***	100.692***	20.171***	23.540***	19.784***	23.540***	19.905***	26.262***
	[0.125]	[0.200]	[0.205]	[6.282]	[7.985]	[6.431]	[8.322]	[6.227]	[7.995]
Observations	180	180	178	177	168	173	168	175	166
R-squared	0.00	0.43	0.41	0.72	0.73	0.73	0.73	0.73	0.75
Long-run effect estimates			-0.674	-0.368	-0.331	-0.319	-0.321	0.025	0.111
			[0.588]	[0.414]	[0.432]	[0.755]	[0.887]	[0.558]	[0.593]

Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%
Source: Author's estimation

TABLE A.3 The variance inflation factors to test collinearity of regressors in regressions of monthly overall CPI (Table A.2)

Explanatory variables in regressions of monthly overall CPI	Model 6 (OLS)		Model 7 (OLS)		Model 8 (OLS)		Model 9 (OLS)	
	VIF	1/VIF	VIF	1/VIF	VIF	1/VIF	VIF	1/VIF
CPI_1 (one-period lag of CPI)	3.59	0.278	3.81	0.262	3.36	0.297	4.00	0.250
CPI_2 (two-period lag of CPI)	4.88	0.205	5.08	0.197	4.36	0.229	4.94	0.203
CPI_3 (three-period lag of CPI)	3.62	0.276	4.07	0.246	3.61	0.277	4.00	0.250
One period lag of annual average CPI			2.23	0.448			2.30	0.435
D1 (one-period lead of D)					1.41	0.710	1.57	0.636
D2 (two-period lead of D)					1.40	0.714	1.47	0.682
D (Dummy variable indicating month with minimum wage increase)	1.39	0.717	1.44	0.694	1.36	0.733	1.39	0.720
D_1 (one-period lag of D)	1.43	0.701	1.47	0.680	1.42	0.703	1.47	0.682
D_2 (two-period lag of D)	1.43	0.699	1.49	0.673	1.42	0.702	1.49	0.669
D_3 (three-period lag of D)	1.45	0.690	1.57	0.639				
D_4 (fourth-period lag of D)	1.46	0.684	1.57	0.636				
D_5 (five-period lag of D)	1.41	0.707	1.49	0.669				
D_6 (six-period lag of D)	1.40	0.713	1.50	0.667				
D_7 (seven-period lag of D)	1.47	0.681	1.48	0.676				
January	2.32	0.431	2.52	0.397	2.68	0.372	3.12	0.321
February	2.42	0.413	2.70	0.370	2.79	0.359	3.30	0.303
March	2.63	0.381	3.12	0.320	2.87	0.348	3.62	0.276
April	4.33	0.231	4.75	0.211	4.26	0.234	4.43	0.226
May	3.76	0.266	4.19	0.239	3.68	0.272	3.93	0.255
June	2.25	0.444	2.40	0.417	2.49	0.402	2.76	0.363
July	2.27	0.441	2.43	0.411	2.46	0.407	2.74	0.365
August	2.41	0.415	2.41	0.415	2.51	0.399	2.77	0.361
September	1.88	0.531	1.95	0.514	2.13	0.470	2.30	0.434
October	1.99	0.503	2.07	0.483	2.48	0.403	2.78	0.360
November	1.99	0.501	2.03	0.492	2.80	0.357	3.03	0.331
December			1.75	0.571			1.72	0.583
One-period lag of growth of annual money supply (M1)			1.97	0.508			1.83	0.546
One-period lag of growth of annual State revenue			1.39	0.719			1.25	0.798
Monthly change in exchange rate (price index of US$)			1.16	0.862			1.23	0.814
Mean	2.35		2.37		2.61		2.64	

Source: Author's estimation

TABLE A.4 Regression of monthly overall CPI (variables of duration around minimum wage increases)

Explanatory variables	Model 1 (FGLS)	Model 2 (FGLS)	Model 3 (FGLS)	Model 4 (OLS)	Model 5 (OLS)	Model 6 (OLS)	Model 7 (OLS)	Model 8 (OLS)	Model 9 (OLS)
Dummy variable indicating month with minimum wage increases and the two following months after that	0.113	-0.101	-0.115						
	[0.242]	[0.183]	[0.145]						
Dummy variable indicating month with minimum wage increases and the seven following months after that				0.037	-0.194	-0.044			
				[0.202]	[0.175]	[0.110]			
Dummy variable indicating a two-month window around minimum wage increases							0.251	0.208	0.063
							[0.219]	[0.184]	[0.120]
CPI_1 (one-period lag of CPI)			0.577***			0.580***			0.580***
			[0.083]			[0.083]			[0.083]
CPI_2 (two-period lag of CPI)			0.033			0.029			0.032
			[0.095]			[0.095]			[0.095]
CPI_3 (three-period lag of CPI)			0.149*			0.142*			0.146*
			[0.085]			[0.085]			[0.085]
January		0.548***	0.366*		0.597***	0.358		0.549***	0.355
		[0.169]	[0.217]		[0.176]	[0.220]		[0.164]	[0.217]
February		1.604***	0.966***		1.652***	0.960***		1.602***	0.954***
		[0.213]	[0.222]		[0.218]	[0.226]		[0.209]	[0.222]
March		-0.885***	-1.960***		-0.836***	-1.966***		-0.888***	-1.974***
		[0.237]	[0.252]		[0.242]	[0.257]		[0.233]	[0.251]
April		-0.485*	-0.381		-0.396	-0.332		-0.365	-0.321
		[0.249]	[0.294]		[0.255]	[0.298]		[0.263]	[0.299]
May		-0.218	-0.406		-0.129	-0.359		-0.099	-0.346
		[0.256]	[0.272]		[0.262]	[0.275]		[0.270]	[0.277]
June		-0.446*	-0.496**		-0.383	-0.471**		-0.328	-0.445**
		[0.258]	[0.213]		[0.259]	[0.214]		[0.271]	[0.223]
July		-0.713***	-0.639***		-0.649**	-0.610***		-0.594**	-0.585***
		[0.255]	[0.214]		[0.257]	[0.215]		[0.269]	[0.223]
August		-0.417*	-0.274		-0.353	-0.243		-0.327	-0.227
		[0.248]	[0.214]		[0.249]	[0.214]		[0.254]	[0.218]
September		-0.362	-0.363*		-0.376	-0.352*		-0.274	-0.32

Explanatory variables	Model 1 (FGLS)	Model 2 (FGLS)	Model 3 (FGLS)	Model 4 (OLS)	Model 5 (OLS)	Model 6 (OLS)	Model 7 (OLS)	Model 8 (OLS)	Model 9 (OLS)
		[0.233]	[0.208]		[0.232]	[0.207]		[0.240]	[0.212]
October		-0.589***	-0.568***		-0.590***	-0.567***		-0.515**	-0.540**
		[0.206]	[0.211]		[0.205]	[0.212]		[0.215]	[0.217]
November		-0.264*	-0.156		-0.265*	-0.153		-0.261	-0.15
		[0.160]	[0.210]		[0.159]	[0.210]		[0.159]	[0.210]
December		Base-omitted							
One-period lag of growth of annual State revenue			0.003			0.003			0.005
			[0.006]			[0.006]			[0.006]
One-period lag of growth of annual GDP			0.038			0.04			0.037
			[0.042]			[0.043]			[0.042]
One-period lag of growth of annual money supply (M1)			0.003			0.003			0.002
			[0.006]			[0.007]			[0.006]
One period lag of annual average CPI			0.004			0.004			0.004
			[0.015]			[0.015]			[0.015]
Month change in exchange rate (price index of US dollar)			-0.007			-0.006			-0.003
			[0.027]			[0.027]			[0.028]
Constant	100.56***	100.77***	24.55***	100.56***	100.78***	25.02***	100.52***	100.65***	24.08***
	[0.124]	[0.202]	[8.007]	[0.141]	[0.202]	[8.210]	[0.127]	[0.220]	[8.022]
Observations	180	180	168	180	180	168	180	180	168
R-squared	0.02	0.43	0.72	0.00	0.43	0.72	0.02	0.43	0.72

Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%
Source: Author's estimation

TABLE A.5 Regression of monthly food CPI

Explanatory variables	Model 1 (FGLS)	Model 2 (FGLS)	Model 3 (FGLS)	Model 4 (OLS)	Model 5 (OLS)	Model 6 (OLS)	Model 7 (OLS)	Model 8 (OLS)	Model 9 (OLS)
D (Dummy variable indicating month with minimum wage increase)	-0.228	0.034	-0.195	-0.23	-0.204	-0.334	-0.362	-0.223	-0.22
	[0.487]	[0.406]	[0.447]	[0.449]	[0.456]	[0.451]	[0.458]	[0.450]	[0.454]
D_1 (one-period lag of D)			-0.622	-0.797*	-0.783*	-0.892**	-0.921**	-0.758*	-0.744
			[0.488]	[0.449]	[0.455]	[0.451]	[0.457]	[0.455]	[0.461]
D_2 (two-period lag of D)			0.125	0.017	-0.097	0.052	-0.114	-0.026	-0.209
			[0.432]	[0.452]	[0.460]	[0.456]	[0.465]	[0.458]	[0.468]
D_3 (three-period lag of D)						-0.824*	-0.963**		
						[0.461]	[0.480]		
D_4 (fourth-period lag of D)						-0.569	-0.747		
						[0.465]	[0.487]		
D_5 (five-period lag of D)						0.351	0.191		
						[0.462]	[0.482]		
D_6 (six-period lag of D)						0.635	0.475		
						[0.462]	[0.483]		
D_7 (seven-period lag of D)						0.452	0.28		
						[0.443]	[0.477]		
D1 (one-period lead of D)								-0.03	-0.146
								[0.455]	[0.478]
D2 (two-period lead of D)								0.443	0.614
								[0.455]	[0.465]
Food_CPI_1 (one-period lag of food CPI)				0.422***	0.398***	0.406***	0.368***	0.421***	0.392***
				[0.077]	[0.082]	[0.080]	[0.083]	[0.077]	[0.082]
Food_CPI_2 (two-period lag of food CPI)				0.059	0.014	0.049	0.017	0.058	0.006
				[0.081]	[0.087]	[0.086]	[0.088]	[0.081]	[0.086]
Food_CPI_3 (three-period lag of food CPI)				0.197***	0.189**	0.229***	0.195**	0.214***	0.207**
				[0.075]	[0.081]	[0.080]	[0.083]	[0.076]	[0.081]
January		0.571	0.617*	0.573	0.43	0.751*	0.635	0.466	0.238
		[0.351]	[0.348]	[0.409]	[0.427]	[0.417]	[0.434]	[0.450]	[0.483]
February		2.598***	2.644***	2.310***	2.206***	2.442***	2.384***	2.184***	1.990***
		[0.385]	[0.411]	[0.412]	[0.431]	[0.420]	[0.441]	[0.453]	[0.487]
March		-1.173***	-1.155***	-2.378***	-2.376***	-2.398***	-2.321***	-2.476***	-2.527***
		[0.415]	[0.421]	[0.427]	[0.458]	[0.443]	[0.482]	[0.459]	[0.503]
April		-0.870**	-0.802*	-0.844*	-0.900*	-0.677	-0.664	-0.971*	-1.107**

Explanatory variables	Model 1 (FGLS)	Model 2 (FGLS)	Model 3 (FGLS)	Model 4 (OLS)	Model 5 (OLS)	Model 6 (OLS)	Model 7 (OLS)	Model 8 (OLS)	Model 9 (OLS)
		[0.430]	[0.426]	[0.471]	[0.491]	[0.527]	[0.552]	[0.501]	[0.531]
May		-0.244	-0.177	-0.518	-0.65	-0.445	-0.455	-0.682	-0.916*
		[0.436]	[0.432]	[0.451]	[0.471]	[0.504]	[0.526]	[0.490]	[0.523]
June		-0.696	-0.63	-0.506	-0.725*	-0.665	-0.788*	-0.605	-0.924**
		[0.438]	[0.434]	[0.371]	[0.392]	[0.406]	[0.420]	[0.416]	[0.452]
July		-1.130**	-1.064**	-0.846**	-0.969**	-1.032**	-1.152***	-0.949**	-1.170**
		[0.436]	[0.432]	[0.376]	[0.399]	[0.418]	[0.432]	[0.419]	[0.456]
August		-0.582	-0.518	-0.211	-0.428	-0.409	-0.554	-0.386	-0.734
		[0.429]	[0.425]	[0.377]	[0.400]	[0.420]	[0.430]	[0.424]	[0.462]
September		-0.471	-0.41	-0.219	-0.484	-0.217	-0.491	-0.323	-0.673
		[0.414]	[0.409]	[0.370]	[0.390]	[0.368]	[0.384]	[0.394]	[0.422]
October		-0.736*	-0.652*	-0.447	-0.696*	-0.41	-0.678*	-0.547	-0.892*
		[0.385]	[0.379]	[0.377]	[0.401]	[0.375]	[0.395]	[0.421]	[0.459]
November		-0.221	-0.097	0.126	-0.124	0.142	-0.122	-0.096	-0.513
		[0.310]	[0.307]	[0.377]	[0.397]	[0.375]	[0.391]	[0.459]	[0.495]
December		Base-omitted							
One-period lag of growth of annual State revenue					0.001		-0.002		-0.004
					[0.011]		[0.011]		[0.011]
One-period lag of growth of annual GDP					0.102		0.116		0.12
					[0.075]		[0.078]		[0.075]
One-period lag of growth of annual money supply (M1)					0.014		0.018		0.019
					[0.012]		[0.013]		[0.012]
One period lag of annual average CPI					0.007		0.006		0.009
					[0.014]		[0.014]		[0.014]
Month change in exchange rate (price index of US dollar)					-0.033		-0.032		-0.034
					[0.050]		[0.050]		[0.051]
Constant	100.74***	100.97***	100.90***	32.662***	41.956***	32.030***	44.053***	31.309***	41.531***
	[0.171]	[0.315]	[0.317]	[7.976]	[10.121]	[8.417]	[10.800]	[8.066]	[10.189]
Observations	180	180	178	177	168	173	168	175	166
R-squared	0.00	0.41	0.39	0.59	0.61	0.62	0.64	0.60	0.62
Long-run effect estimates			-1.543	-1.009	-1.084	-1.129	-2.160	-0.594	-0.706
			[0.923]	[0.780]	[0.805]	[1.443]	[1.732]	[1.074]	[1.129]

Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%
Source: Author's estimation

TABLE A.6 Regression of monthly food CPI (variables of duration around minimum wage increases)

Explanatory variables	Model 1 (FGLS)	Model 2 (FGLS)	Model 3 (FGLS)	Model 4 (OLS)	Model 5 (OLS)	Model 6 (OLS)	Model 7 (OLS)	Model 8 (OLS)	Model 9 (OLS)
Dummy variable indicating month with minimum wage increases and the two following months after that	0.384	-0.009	-0.363						
	[0.382]	[0.334]	[0.268]						
Dummy variable indicating month with minimum wage increases and the seven following months after that				-0.102	-0.302	-0.265			
				[0.304]	[0.283]	[0.217]			
Dummy variable indicating a two-month window around minimum wage increases							0.459	0.273	-0.065
							[0.339]	[0.318]	[0.222]
Food_CPI_1 (one-period lag of food CPI)			0.396***			0.390***			0.408***
			[0.081]			[0.082]			[0.081]
Food_CPI_2 (two-period lag of food CPI)			0.016			-0.002			0.012
			[0.086]			[0.087]			[0.087]
Food_CPI_3 (three-period lag of food CPI)			0.185**			0.167**			0.184**
			[0.080]			[0.082]			[0.081]
January		0.586*	0.446		0.700**	0.48		0.611*	0.358
		[0.326]	[0.394]		[0.334]	[0.401]		[0.316]	[0.395]
February		2.599***	2.018***		2.714***	2.068***		2.621***	1.925***
		[0.393]	[0.398]		[0.398]	[0.408]		[0.385]	[0.398]
March		-1.171***	-2.315***		-1.056**	-2.239***		-1.150***	-2.427***
		[0.423]	[0.447]		[0.427]	[0.465]		[0.417]	[0.445]
April		-0.872**	-0.944*		-0.753*	-0.715		-0.738	-0.899*
		[0.433]	[0.486]		[0.440]	[0.497]		[0.458]	[0.501]
May		-0.246	-0.677		-0.128	-0.478		-0.113	-0.65
		[0.439]	[0.463]		[0.446]	[0.475]		[0.465]	[0.477]
June		-0.698	-0.767**		-0.62	-0.663*		-0.565	-0.748*
		[0.441]	[0.387]		[0.440]	[0.388]		[0.466]	[0.406]
July		-1.132**	-1.013**		-1.054**	-0.895**		-0.999**	-0.985**
		[0.439]	[0.394]		[0.438]	[0.394]		[0.464]	[0.413]
August		-0.584	-0.469		-0.506	-0.35		-0.486	-0.429
		[0.432]	[0.394]		[0.432]	[0.394]		[0.445]	[0.404]
September		-0.473	-0.525		-0.515	-0.515		-0.376	-0.493

Explanatory variables	Model 1 (FGLS)	Model 2 (FGLS)	Model 3 (FGLS)	Model 4 (OLS)	Model 5 (OLS)	Model 6 (OLS)	Model 7 (OLS)	Model 8 (OLS)	Model 9 (OLS)
		[0.417]	[0.385]		[0.414]	[0.385]		[0.429]	[0.395]
October		-0.732*	-0.717*		-0.735*	-0.717*		-0.637	-0.735*
		[0.382]	[0.389]		[0.380]	[0.389]		[0.397]	[0.402]
November		-0.221	-0.226		-0.223	-0.219		-0.218	-0.217
		[0.310]	[0.384]		[0.310]	[0.385]		[0.308]	[0.387]
December		Base-omitted							
One-period lag of growth of annual State revenue			0.001			-0.003			0.003
			[0.011]			[0.012]			[0.011]
One-period lag of growth of annual GDP			0.104			0.126			0.098
			[0.075]			[0.078]			[0.075]
One-period lag of growth of annual money supply (M1)			0.015			0.019			0.013
			[0.012]			[0.013]			[0.012]
One period lag of annual average CPI			0.007			0.007			0.007
			[0.014]			[0.014]			[0.014]
Month change in exchange rate (price index of US dollar)			-0.034			-0.03			-0.033
			[0.050]			[0.050]			[0.051]
Constant	100.67***	100.97***	42.59***	100.76***	101.02***	46.14***	100.63***	100.84***	41.78***
	[0.173]	[0.319]	[10.062]	[0.199]	[0.314]	[10.768]	[0.181]	[0.353]	[10.186]
Observations	180	180	168	180	180	168	180	180	168
R-squared	0.01	0.41	0.61	0.00	0.42	0.61	0.01	0.41	0.60

Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%
Source: Author's estimation