ON THE PROCESS OF WAGE ADJUSTMENT IN US AND PA: USING THE PHILLIPS-TYPE MODEL

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ABSTRACT

The adjusted Phillips-type model does a decent job in explaining wage adjustment for both the U.S. and PA manufacturing sector, showing a typical adjustment to price inflation expectation and the labor market tightness. Interestingly, however, it is shown that the US wage adjusts to the *long-run* labor market force, while the PA manufacturing wage adjusts to a short-run change in the labor market. The adjustment of the PA wage to price inflation expectation, on the other hand, appears to be much bigger for the PA manufacturing sector. When alternative demographic variables of unemployment are included in the model, the effect of aggregate unemployment rate is completely captured by one of the variables, the percent of unemployed of age 25 and older for the national model. The PA model also shows a significant effect of the same variable. This finding leads us to the suggestion that aggregate unemployment might not be a very effective measure of the labor market tightness and also that the effect of the long-run labor market force for the PA wage is revealed in a different way, only when alternative demographic variables are included in the model.

INTRODUCTION

The history of US economy reveals that both price and wage inflation followed a fairly predictable pattern in relation to the business cycle - it increased during an economic expansion, peaking slightly after the beginning of a recession, and then continued to decrease through the early stage (first or second year) of a recovery. It has been reported, however, that US inflation during the post-1991 period showed a noticeably different pattern. The rates of price and wage inflation have been surprisingly low during the post-1991 period, and failed to accelerate despite strong real growth and a falling unemployment rate until the late 1990s. The traditional Phillips curve models have tended to overpredict actual inflation for the post-1991 inflation.

Lown and Rich (1997) found that traditional Phillips curve model overpredicts price inflation during the 1990s recovery, and that it is partially explained by unusually low wage (compensation) growth, but the reason why it was like it was left unanswered. Duca (1996) also found that wage inflation is overpredicted by the basic Phillips curve model, and that the unusually high duration of unemployment add more information to explain the unexplained portion of wage inflation for the post 1991 period. Hyclak and Ohn (2001), using an adjusted wage Phillips curve model, confirmed the finding of Lown and Rich on the overprediction of the traditional Phillips curve model and Duca's finding on the negative effect of unemployment duration in forecasting the wage (compensation) inflation during the 1990s recovery. They further showed that, while the unemployment duration moved in tandem with the lagged unemployment rate until about the end of the 1991 recession, the post-1991 duration has been surprisingly higher than can be tracked by the unemployment rate and remained close to peak value until the mid-1990s. Hyclak and Ohn also showed the significant role of demographic variables in explaining the unusually high unemployment duration during the post-1991 recovery and conclude that recent change in the labor market such as technological change and corporate restructuring might be expected to result in a high fraction of older workers and a longer duration of unemployment for those groups, which should have a significant negative effect on wage inflation.

This paper performs a comparative analysis on the process of wage adjustment in US and PA State, especially focusing on the relationship between wage inflation, price inflation expectation, and unemployment rate and demographic variables, using a basic and adjusted Phillips-type wage models. Importantly, we check if the above overprediction pattern still exists in wage adjustment during the 2000s, and if the adjustment pattern found in the national level is also found in the PA State level. Importantly, we will examine how effectively the adjusted wage model explains and predict actual wage adjustment, both quantitatively and graphically.

DATA AND TEST MODEL

We examine the quarterly wage adjustment using a relatively simple Phillips-type model of wage

adjustment, which follows the specification of Alogoskoufis and Smith (1991) and Hyclak and Ohn (1997, 2001). It represents labor market forces by the lagged level of unemployment as well as current change of unemployment, and controls for inflation expectation first by the lagged price inflation and then by expected rate of price inflation. Our basic test model is

$$\Delta w_t = \beta_0 + \beta_1 E(\Delta p_t) + \beta_2 u_{t-1} + \beta_3 \Delta u_t + e_t$$

where Δw_t is quarter-to-quarter wage inflation, u_{t-1} is the lagged level of unemployment, Δu_t, is the current change of unemployment, and $E(\Delta p_t)$ is price inflation expectation. In the basic model (M I), the lag of actual price inflation, Δp_{t-1}, proxies for price inflation expectation, while in the adjusted models (M II, III, and IV), expected rate of GDP price inflation projected at the end of the previous period, $E(\Delta p_t)$, from the Survey of Professional Forecasters at the Federal Reserve Bank of Philadelphia, is included to control for price inflation expectation. The lagged level of the unemployment rate is expected to represent a *long-run* change in the labor market force, and a current change of the unemployment rate to capture a *short-run* change in the labor market force. The three alternative variables are included to reflect the recent labor market change which has not been fully captured by aggregate unemployment as suggested by Duca (1996) and Hyclak and Ohn (2001) - the duration of unemployment, *DUR*, the percent of unemployed of age 25 and older, *R25*, and the fraction of unemployed due to permanent jobloss, *JOBL*. The adjusted model is

$$\Delta w_t = \beta_0 + \beta_1 E(\Delta p_t) + \beta_2 u_{t-1} + \beta_3 \Delta u_t + \beta_4 DUR_{t-1} + \beta_5 R25_{t-1} + \beta_6 JOBL_{t-1} + e_t$$

Including the duration of unemployment, *DUR*, is based on the hypothesis that the longer a worker is unemployed, the lower wage the worker is willing to accept, thus lowering the reservation wage of the worker. It is particularly true for the unemployed that result from skill-biased technology change and resulting structural unemployment. Including the percent of unemployed of age 25 and older is based on the hypothesis that, considering skill-biased technology change and corporate downsizing have a more serious impact on older workers, the higher the percent of unemployed of age 25 and older, the lower wage the workers are willing to accept[xxxi] We thus expect a significant negative effect of those two alternative variables on wage adjustment model. Including the percent of unemployed due to permanent job-losing is based on the hypothesis that, the higher the percent of permanent job-losing, the lower wage the workers are willing to accept. We again expect a significant negative effect of those two alternative variables on wage adjustment model.

The wage and the unemployment rate for the national and PA state used in this paper are available at the Bureau of Labor Statistics (BLS). The national wage data we use include total hourly compensation for the national non-farm business sector and the PA wage is for the PA manufacturing sector. The duration of unemployment, the percent of unemployed of age 25 and older, and the unemployed due to permanent job loss are obtained from the Current Population Survey. The expected price inflation is the rate of GDP price inflation reported at the Survey of Professional Forecasters by the Federal Reserve Bank of Philadelphia.

ESTIMATION RESULTS

Table 1 on page 177 summarizes the estimation results on the four different versions of the Phillips-type wage adjustment models. The first model (M I) is the very basic wage model which includes three basic variables: lagged price inflation (a proxy for price inflation expectation), lagged unemployment rate (*long-run market force*), and current change in unemployment rate (*short-run change in labor market force*). The second model (M II), while controlling for a quarter-to-quarter persistence of wage inflation by including lagged wage inflation, controls for price inflation expectation by including expected price inflation (from the Philadelphia FED) directly. The duration of unemployment is included in the third model (M III), and then two additional labor market variables are included in the fourth model (M IV), in order to capture the effect of recent labor market force, which may not have been fully captured by aggregate unemployment. In all four models, the effect of price inflation expectation is shown to be a major factor in wage iadjustment. Both the US and PA models show a significant coefficient for price inflation expectation. It is shown, however, that the adjustment to price inflation expectation is much better explained by directly including expected price inflation rather than lagged actual price inflation. When we replace lagged price inflation with expected price inflation in Model II, the coefficient for the variable has increased significantly from 0.45 to 0.99 for the US, and from 0.43 to 1.29 for the PA, and R^2 increased from 0.33 to 0.53 for the US results and from 0.32 to 0.38 for the PA results. Interestingly,

the magnitude of wage adjustment to price inflation expectation is much larger for the PA manufacturing wage. While the effect of labor market tightness is not captured in the first model (M I), even showing a mis-fitting in the PA wage, it is clearly revealed in the second model (M II) but in different way – the national wage shows a significant effect of the long-run labor force, -0.69 (lagged unemployment), but the PA wage shows a significant effect of the short-run change in the market force, -2.12 (current change in unemployment rate).

When an alternative unemployment variable (duration of unemployment) is included in the third model (M III), the significant effect of lagged unemployment rate (long-run market force) for the national level is completely captured by the duration of unemployment (-0.35), with little impact on the PA wage, which seems to lead to the suggestion that aggregate unemployment rate might not be a very effective measure of the labor market tightness in the national wage adjustment.

When we include two additional variables of labor market - the percent of unemployed of age 25 and higher, $R25_{t-1}$, and the percent of unemployed due to permanent jobloss, $JOBL_{t-1}$, in the fourth model (M IV), the significant effect of unemployment duration in the national level is completely captured by the effect of *R25* (-0.25), with no significant effect of *JOBL* in the national model. Interestingly, however, the PA wage model shows a significant effect of *R25* (-0.36), along with a significant effect of current change in unemployment rate, Δu_t (-2.06). It appears that while the adjustment of the PA wage to a short-run market force is easily captured in the basic adjusted model, its adjustment to the long-run labor force is only revealed in the form of a significant effect of the percent of unemployed of age 25 and older, *R25*, as shown in Model IV.

Figure 1 on page 178 compares actual and forecasted wage inflation for the post-1991 period to the mid-2000s. The upper graphs show actual and predicted wage inflation for the US and PA based on the very basic model, Model I. The US model clearly shows overprediction pattern not only during the 1990s period, which is consistent with Duca (1996), Lown and Rich (1997), and Hyclak and Ohn (2001), but it is also found during the 2000s. Interestingly, however, the PA model does not show any overprediction pattern during the 1990s period, but it is found during the mid-2000s, starting around 2003. The lower graphs which compare actual and predicted wage inflation based on the adjusted Phillips-type wage model in Model IV for both US and PA. Most of the overprediction pattern both in the US and PA model disappears, and it shows a significantly improved predicting power for both the U.S. and PA level. It suggests that 1) the adjusted wage model with direct measure of expected price inflation in the model fits actual wage inflation better and 2) alternative demographic variables not only add to the explanatory or predictive power in the model, which was not well explained by aggregate unemployment rate, but also capture its effect in the national wage adjustment, and 3) the adjustment of the PA wage to the long-run labor force is only revealed by the adjusted wage model with alternative demographic variables (M IV), not by the basic model (M I or II or III).

CONCLUSION

In this paper, we performed a comparative examination on the wage adjustment to price inflation and the labor market forces represented by the unemployment rate and three demographic variables of unemployment for the US non-farm business and PA manufacturing sector. First, we find that the wage Phillips-type models do a decent job in explaining wage adjustment for both the U.S. and PA level. We find a typical strong positive adjustment to price inflation expectation and a typical negative adjustment to the labor market tightness represented by the unemployment variables in both the US and PA results. However, while the US wage shows a significant adjustment to a long-run change in the labor market, the PA manufacturing wage shows a prompt adjustment to a short-run change in the labor market force. With the three alternative variables of labor market forces, we find that the adjustment of the US wage to aggregate unemployment is completely captured by the significant effect of the percent of unemployed of age 25 and older, implying that the alternative variable reflect the recent labor market force more effectively. The PA wage still shows a significant adjustment to a short-run change in the labor market, but its adjustment to a long-run labor market change is revealed in the form of a significant effect of the same variable, the percent of unemployed of age 25 and older, R25.

The comparison of actual and forecasted wage inflation based on a very basic model shows that the US model shows overprediction pattern not only during the 1990s period but during the 2000s, while the PA model shows the overprediction pattern during the mid-2000s. The actual and predicted wage inflation based on the adjusted wage model with three alternative demographic variables shows that

most of the overprediction pattern both in the US and PA model disappears. It suggests that the adjusted wage model with direct measure of expected price inflation and alternative demographic variables not only add to the explanatory or predictive power of the wage model, but also capture the effect of aggregate unemployment rate in the wage adjustment. Importantly, the adjustment of the PA wage to the long-run labor force is only revealed by the adjusted wage model with alternative demographic variables (M IV).

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[xxxi] The BLS database divides the entire unemployed in three age groups – age of 16-24, 25-54, and 55 and over. Considering the skill-biased technological change and corporate downsizing is likely to have more serious impact on older workers in the major work force, *R*25 is expected to capture the impact of recent labor market forces above, as shown in Hyclak and Ohn (2001).

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Table 1. Test Results on the Phillips-Type Wage Model for the U.S. and PA, 1975-2005

Regression Results

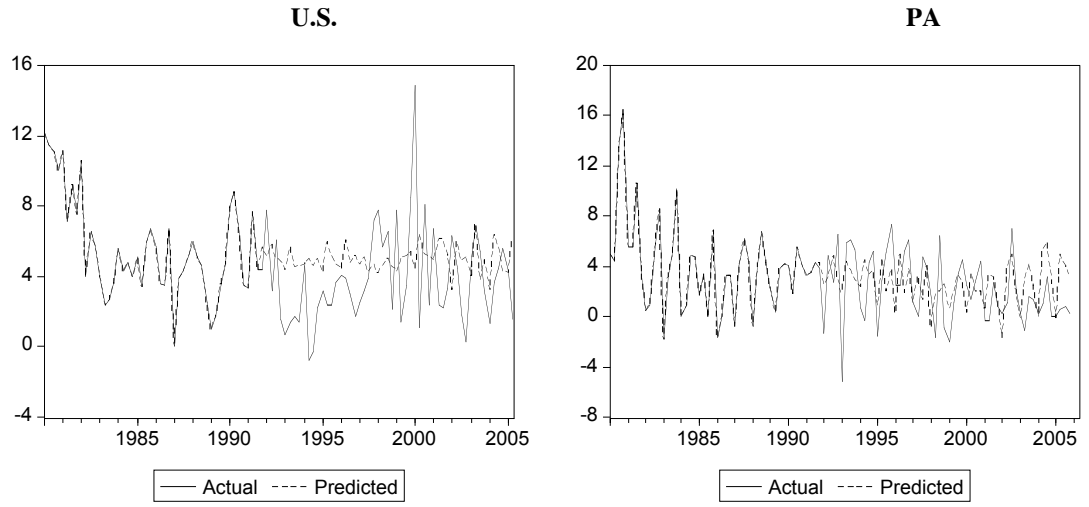
	United States				Pennsylvania State			
	M I	M II	M III	M IV	M I	M II	M III	M IV
Constant	3.38**	4.40**	7.97**	16.69**	-0.77	0.62	2.06**	19.28*
	(1.09)	(0.98)	(1.48)	(3.46)	(1.10)	(1.05)	(2.73)	(8.22)
Δw_{t-1}		0.25**	0.16^{+}	0.07		0.03	0.02	0.00
		(0.08)	(0.09)	(0.09)		(0.10)	(0.10)	(0.10)
E(Δp_t)[a]	0.45**	0.99**	0.80**	0.47**	0.43*	1.29**	1.20**	0.68*
	(0.08)	(0.16)	(0.17)	(0.14)	(0.07)	(0.22)	(0.30)	(0.31)
u_{t-1}	-0.02	-0.69**	-0.24	-0.34	0.40*	-0.31	-0.24	-0.47
	(0.17)	(0.18)	(0.22)	(0.34)	(0.16)	(0.19)	(0.30)	(0.37)
Δu_t	1.02	0.22	-0.45	-0.13	-0.82	-2.12**	-2.40**	-2.06^{+}
	(0.73)	(0.62)	(0.63)	(0.69)	(0.94)	(0.95)	(1.05)	(1.17)
DUR_{t-1}			-0.35**	-0.10			-0.10	0.00
			(0.11)	(0.13)			(0.21)	(0.19)
$R25_{t-1}$				-0.25**				-0.36*
				(0.06)				(0.16)
$JOBL_{t-1}$				0.10				0.14
				(0.09)				(0.14)
R^2	0.33	0.53	0.57	0.60	0.32	0.38	0.38	0.41
DW	1.68	2.13	2.10	2.05	1.68	1.93	1.94	1.97

[a] E(Δp_t) is expected price inflation based on the GDP price inflation, which is reported by the Federal Reserve Bank of Philadelphia. In the very basic model in Model I, however, it is the lag of actual price inflation, Δp_{t-1}, from the Bureau of Labor Statistics.

In the regression results, standard errors of the coefficients are in (parentheses). ** significant at the 1%, * significant at the 5%, $^{+}$ significant at 10%.

Figure 1. Actual vs Forecasted Wage Inflation based on Model 1: U.S. vs PA

A. Actual vs Forecasted Wage Inflation Based on Model 1, 1992-2005.



B. Actual vs Forecasted Wage Inflation Based on Model IV, 1992-2005