Labor Productivity, Inflation, and Unemployment's Relationship with Wage Formation in the United States.

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Abstract:

This paper discusses unemployment, labor productivity and inflation's effect on wage formation in the United States. This paper looks at a very well researched topic of wage formations relation to unemployment and labor productivity to see if there is a long term homogenous relationship between the wage levels and the dependent variables. By using quarterly data from 1996 to 2009, I will attempt to observe if wages are following the classical theoretical relationship in the United States. The specified time period will allow us to observe a distinct boom and bust in the economy. I expect to find a long term relationship between wages and productivity, but not the others.

JEL Classification: E2, E3, F1

Keywords: Wage Formation, Labor Productivity, Unemployment.

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1.0: Introduction

This paper attempts to observe wage formation in the United States from 1996 to 2009. This allows us to gain a perspective on wage formation in distinct boom and bust periods for the American economy. In theory we should expect high unemployment to lower nominal wages. Theoretically wage levels should experience a positive relationship with productivity. Theory predicts that real shocks such as productivity increases should have long term effects on wage levels. Whereas, with shocks considered nominal such as inflation levels and unemployment it is expected to possibly see a short run relationship, but it is unlikely it holds in the long run.

Throughout the late 1990's we see a distinct boom in the economy as productivity made huge strides, due in large part to the integration of the personal computer and the internet into everyday business in America. In the first quarter of 2001 the US economy was experiencing a boom period with low unemployment and high productivity. By the fourth quarter with the bombing of the world trade center and the declining equity markets we can observe a beginning of a recession. As the economy rebounded we see a rebound in productivity growth starting in 2003's second quarter, and by the third quarter we see unemployment start to shrink hitting a low point in 2006 when the economy was hitting a peak in the business cycle. During the period between 2003 and 2006 where we see low unemployment we also see stagnation in productivity gains.

From the beginning of 2007 to the fourth quarter of 2009 we see increasing levels of unemployment, attributed in part to the onset of the most recent recession and the crashing real estate and equity markets, and the low consumer confidence and spending being experienced during this period. During the period from the third quarter of 2007, when equity markets crashed, we see stagnation in productivity gains, with negative growth in the first and third quarters of 2008, productivity growth starts to pick up in second quarter of 2009. We can attribute this to the fact that the hour's variable in the output per hours worked proxy for productivity was reduced due to high unemployment.

I intend to observe if the classical relationships hold true for wage determinants in the US. That is productivity should determine wages, while inflation and unemployment should cause temporary shocks to wage level. I would also like to compare my results to those that were found by (Eriksson, 2005; Kumar et al., 2009) studies on wage formation in Sweden and Australia effectively. We should find slight differences in our results due to differences in labor market structure differences among countries.

My paper will have the following set up. In Section 2 I will observe trends in the data. In Section 3, I will perform a literature review which will discuss some of the information found on the topic from previous studies done in Sweden and Australia. Section 4 will show the layout of the methods used to derive the regression and a specification of data used. Section 5 will focus on empirical results, which will be the section where the actual regression results will be shown. Section 6 will be the data interpretation section where the regression data will be further explained. Section 7 will be the conclusions section where I will compare my results to my hypothesis and try and explain discrepancies from my original hypothesis.

2.0: Trends

It is evident that over the last thirteen years workers have seen an increase in their earnings, but in recent years there has been a decrease in wages since the onset of the most recent recession. Unemployment levels seem to have a direct relationship with employee earnings for two reasons. For one, when large numbers of the population are unemployed workers are more content keeping a job with lower pay just because they know their options may be limited if they leave their place of employment in an unfavorable job market. Also with large amounts of people losing their jobs, there will be people accepting jobs that they are overqualified for until a job that meets their education and experience levels open up. In the mid to late nineties we see a booming economy, as the computer industry, and ecommerce take rise. In this kind of environment people feel more secure that they will be able to find a job if they lose theirs so they are willing to take chances in trying to advance their careers. After 2001 when we see a series of

unfortunate events for American workers, such as the dot com crash and the fall of the World Trade Towers, we see unemployment levels rise and shrinking earnings for employees. In 2003 when we see unemployment levels start to change direction and a higher percent of the workforce is employed we see employee earnings return to an upward trend. We see that upward trend until 2008, which is shortly after unemployment trend started to increase in 2007, when the most recent recession hit and the real estate and equity markets burst. After 2008 we see the sharpest decline in employee earnings and employment that we see over the observed 13 years.

Labor productivity theoretically should a long term positive relation with wages, which over a relative long run we have seen. Labor productivity in the US has seen a relatively stable increase since 1996, with slightly more accelerated increases during the 1990's to about 2003. This is largely due to the technological advances in computers, as computer technology has increased from 1996 to 2003 an individual workers output increased relative to the hours worked. Since 2003 there have been technological advances but not at the rate we saw throughout the late 1990's and early 2000's. We still see an increase in labor productivity until 2008 where we see a sharp increase in labor productivity. This was brought on by the recession, where employers were looking to cut costs and push fewer employees to take on larger workloads to reduce costs. The hour's portion of the output per hours worked equation was effectively lowered making overall labor productivity higher.

Inflation has a somewhat similar relation to employee earnings as labor productivity as inflation has somewhat steadily increased throughout the last thirteen years there has been a long run overall increase in wages to satisfy workers purchasing power. This is evident because even in the most recent recession where employee earnings had a sharp decline they still are higher than the levels they were at in 1996.

Figure 1: Total Employee Earnings

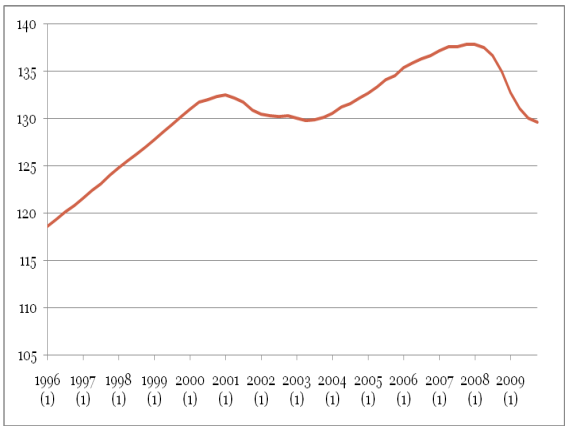


Figure 2: Unemployment Rate

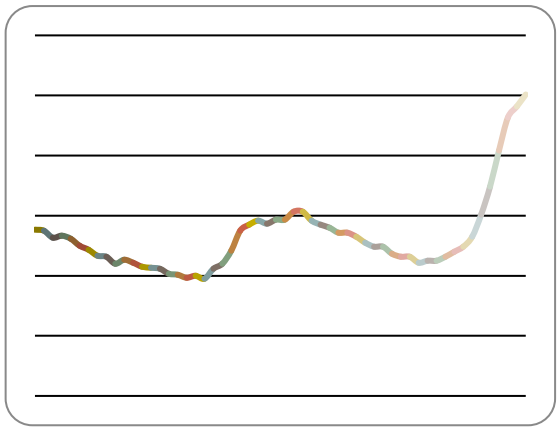


Figure 3: Labor Productivity (Output/Hour)

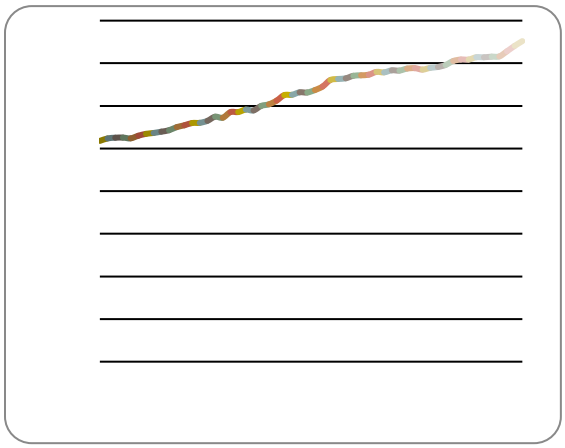
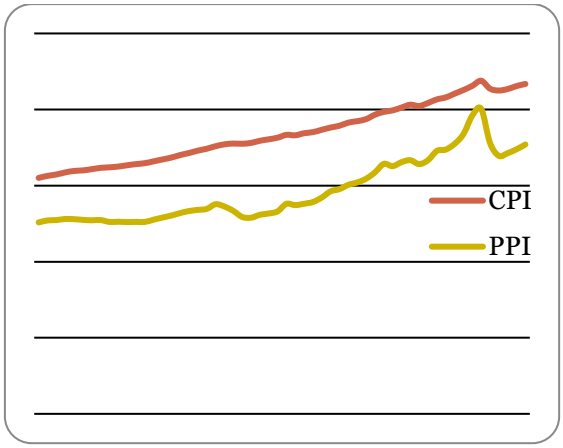


Figure 4: Producer and Consumer Price Indices



Source: Author's compilation

3.0: Literature Review

There have been a number of studies done for the effects of labor productivity, inflation and unemployment on wage formation and wage formation. Although different countries have different labor structures we can use some of the studies done to describe wage formation in countries such as Sweden and Australia, both which are relatively open and developed economies, as a framework to develop ideas and conclusions about wage formation in the United States. The studies done for the wage formation in the United States have taken a look at smaller number of variables with some OLS approaches.

Eriksson (2005), has observed the wage formation in Sweden with the objective of studying how imbalances in the labor market restore themselves to equilibrium. One of Eriksson (2005) main findings is that wage levels are heavily dependent on productivity and price, but unemployment levels are huge bargaining chips used by unions in wage bargaining process. Blanchard and Katz (1999) in found in their study a negative relationship between real wage and unemployment. The unions in Sweden have a more active role in the wage formation process than in the United States, causing a higher degree of wage rigidity, so we should expect the unemployment relationship to be relatively diminished. Petursson and Slok (2001) found wage rigidity to be a major cause of unemployment in Sweden as when PPI raises and the wage rigidity causes a decreased profit margin firms will lay off workers. Eriksson (2005) also make the distinction between real shocks to the economy such as productivity, and technological advances, and nominal shocks such as inflation and the unemployment rate. The argument is that nominal shocks should have only temporary affects on wage formation, whereas, real shocks should have longer term, more permanent effects. Eriksson (2005) also observes the gap between CPI and PPI, citing that high CPI gives union's bargaining power in the wage negotiations, while high PPI gives employers the upper hand in the bargaining process.

Jacobson et al, (1996) did a study looking for the relationship between real wage and unemployment. Jacobson el al, (1996) determined that real wage, employment and output were driven by labor supply and technology shocks. It was found that unemployment predominately caused by demand shocks, such as low levels of consumption. Jacobson et al, (1996) found that unemployment had no long term relation with real wages, which confirms Eriksson (2005) study in finding unemployment as a nominal shock does not have long term effects on wage relation. Jacobson et al, (1996) study found that negative demand shocks led to increased unemployment and a lagged decrease in real wage.

Kumar et al, (2009) did a study on the relation of real wages and labor productivity in Australia. Kumar et al, (2009) found a bidirectional causal relationship between labor productivity and real wages. The argument behind this finding is that increased productivity allows for the

employer to pay higher nominal wages, and higher wages give employees more incentive to increase output levels. Kumar et al, (2009) found a weak negative relationship between inflation and productivity, arguing that the decreased purchasing power found in an inflationary environment gives workers less incentive to work hard.

4.0: Data and Empirical Methodology

$$\Delta Xt = \Pi Xt - 1 + \Sigma\Gamma\Delta\mathrm{Xt} - 1 + \mu + \alpha\delta + \varepsilon$$

The nominal wage level is measured using total employee earnings as a proxy. Total employee earnings take in total employee earnings gained per hours worked on a nationally aggregated level. Both producer and consumer price indices are used to measure inflation from the producer's and consumer's perspective. Both of these inflation measures collected by the Bureau of Labor Statistics (BLS) use an average basket of goods that a typical producer or consumer uses and indexes them to see the change in price levels. The national unemployment rate was used to measure levels of unemployment. The BLS takes the number of unemployed workers that are considered in the workforce which excludes workers who have given up on looking for work and divides this number by the total labor force. Labor Productivity is measured by output per labor hours, which measures how much is produced per hours worked.

With nominal wage level as the dependent variable I will run a cointegrated vector autoregression (VAR) regression with the Granger Causality test to see if the relationships between these variables are Granger causal and can be used to accurately predict the wage level in the long run. Table I provides some descriptive statistics about the variables used.

Table 1: Unit Root Test.

Method	Statistic @ Level	Statistic @ First Diff.	Prob. @ Level	Prob. @ First Diff.
ADF- Fisher Chi-square	5.46667	94.2335	0.8579	0.0000
PP- Fisher Chi-square	4.58969	85.0085	0.9169	0.0000

Source: Author's compilation.

I will run the unit root test to achieve stationary data. After my data is stationary the next step is to run a cointegration rank test that will give me my appropriate lag length to run my Granger Causality as well as the appropriate rank in which to run the VAR model. The Granger Causality test will give us an idea to the structure of relationships. It will allow me to determine if a relationship is causal and in which direction. I will use an impulse response tests to find out what kind of responses the variables will have with shocks to the dependent variables.

4.1: Cointegration Rank Test

After running the unit root at level the data was not stationary, so I ran the unit root at first differences to achieve stationary data that would allow me to run VAR analysis. This effectively removed the trends from the data. My next step was to run the Unrestricted Cointegration Rank Test (Trace) and (Max Eigenvalue), which would allow me to determine the appropriate number of lags to use while running Granger Causality Tests and my VAR regression. Table III shows the results of the Trace and Maximum Eigenvalue Test.

Table 2: Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.624792	88.76435	69.81889	0.0008
At most 1	0.260771	36.80984	47.85613	0.3566
At most 2	0.229409	20.79604	29.79707	0.3705
At most 3	0.102785	6.984383	15.49471	0.5795
At most 4	0.023051	1.236002	3.841466	0.2662

Trace indicates 1 cointegrating eqn(s) at .05 level, *denotes rejection of hypothesis at .05 level, ** MacKinnon-Haug Michelis (1999) p-values.

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.624792	51.95451	33.87687	0.0001
At most 1	0.260771	16.01380	27.58434	0.6646
At most 2	0.229409	13.81165	21.13162	0.3807
At most 3	0.102785	5.748380	14.26460	0.6457
At most 4	0.023051	1.236002	3.841466	0.2662

Max-Eigen indicates 1 cointegrating eqn(s) at .05 level, *denotes rejection of hypothesis at .05 level, ** MacKinnon-Haug Michelis (1999) p-values

Source: Author's compilation

The lowered Eigenvalue at most four numbers of CEs of (0.023051), and the significant drop in the Trace Statistic from (6.984383) to (1.236002), as well as the drop in the Max-Eigen Statistic from (5.7483880) to (1.236002) is appropriate to run the Granger Causality Test with a lag of four. The next step is to run the Granger Causality Test at four lags to determine the relationship each variable has with one another.

4.2: Granger Causality Test

The point of the Granger Causality Test is to test whether each variable is Granger Causal on the other variable. The Granger Causality Test tests the variables predictive capabilities of each variable on one another. In testing each combination of variables we can observe the directional relationship between variables. In running this test we can hope to explain some of the trends seen in the data, but now be able to tell which variable is acting dependently in the relationship. I ran the test assuming 95% confidence interval, we can therefore reject any null relationship with a probability value greater than (0.05).

Table 3: Granger Causality Results

Null Hypothesis:	Obs	F-Statistic	Prob.
CPI does not Granger Cause Employee Earnings	52	3.04831	0.0268
Employee Earnings does not Granger Cause CPI		4.78037	0.0028
PPI does not Granger Cause Employee Earnings	52	3.28318	0.0196
Employee Earnings does not Granger Cause PPI		5.03051	0.0020
Labor Productivity does not Granger Cause Employee Earnings	52	1.32638	0.2755
Employee Earnings does not Granger Cause Labor Productivity		3.82776	0.0095
Unemployment does not Granger Cause Employee Earnings	52	1.28022	0.2926
Employee Earnings does not Granger Cause Unemployment		6.06561	0.0006

Source: Author's compilation

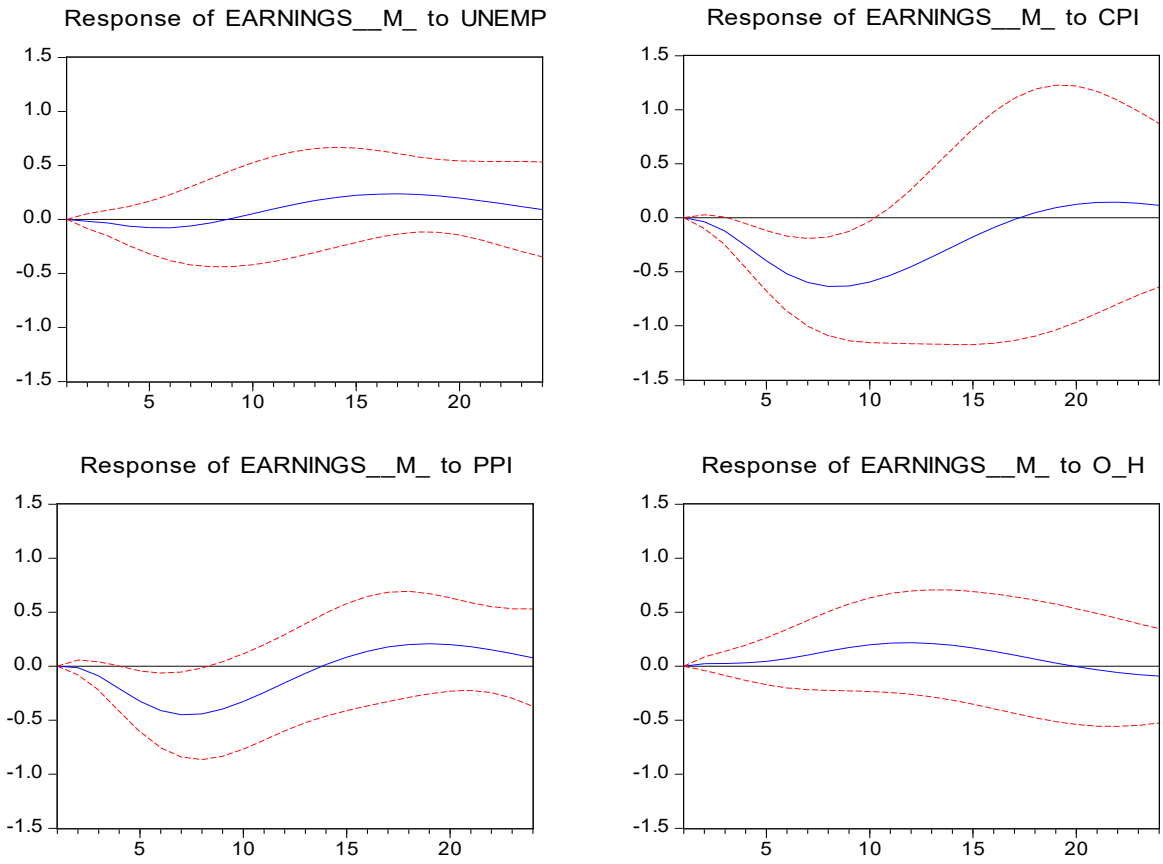
After running the Granger Causality Test we can determine by observing the stated probability values which values are Granger Causal. We observe that CPI and Employee Earnings are bidirectional Granger Causal, along with PPI and Employee Earnings. While both CPI and PPI are bidirectional causal with employee earnings the causal relationship with employee earnings and PPI is slightly stronger than that of CPI. This suggests that producers may have a stronger position in the wage determination process, which is expected since they are the ones paying the employees. While it can be observed that Labor Productivity does not Granger Cause Employee Earnings, Employee Earnings does Granger cause Labor Productivity.

This suggests that increased pay to employees may be responsible to motivating workers to create higher output per hour. This example of increased wages increasing the labor productivity shows the efficiency wage argument, a similar finding to the research of (Alexander, 1993) done in the U.K. Another relationship we can observe is Unemployment does not Granger Cause Employee Earnings, but Employee Earnings does Granger Cause Unemployment. This finding suggests as wages decrease workers become less inclined to work. This may indicate that the unemployment insurance system in the U.S. may be dissuading workers to look for employment in a recession when lower wages are being offered. CPI and PPI have a bidirectional Granger Causal relationship, as we must reject the null. PPI and CPI have a bidirectional Granger Causal relationship with Unemployment. Other one way directional Granger Causal relationships include PPI's Granger causal relationship with Labor Productivity, and Unemployment Granger Causality to Labor Productivity.

4.3: Impulse Response

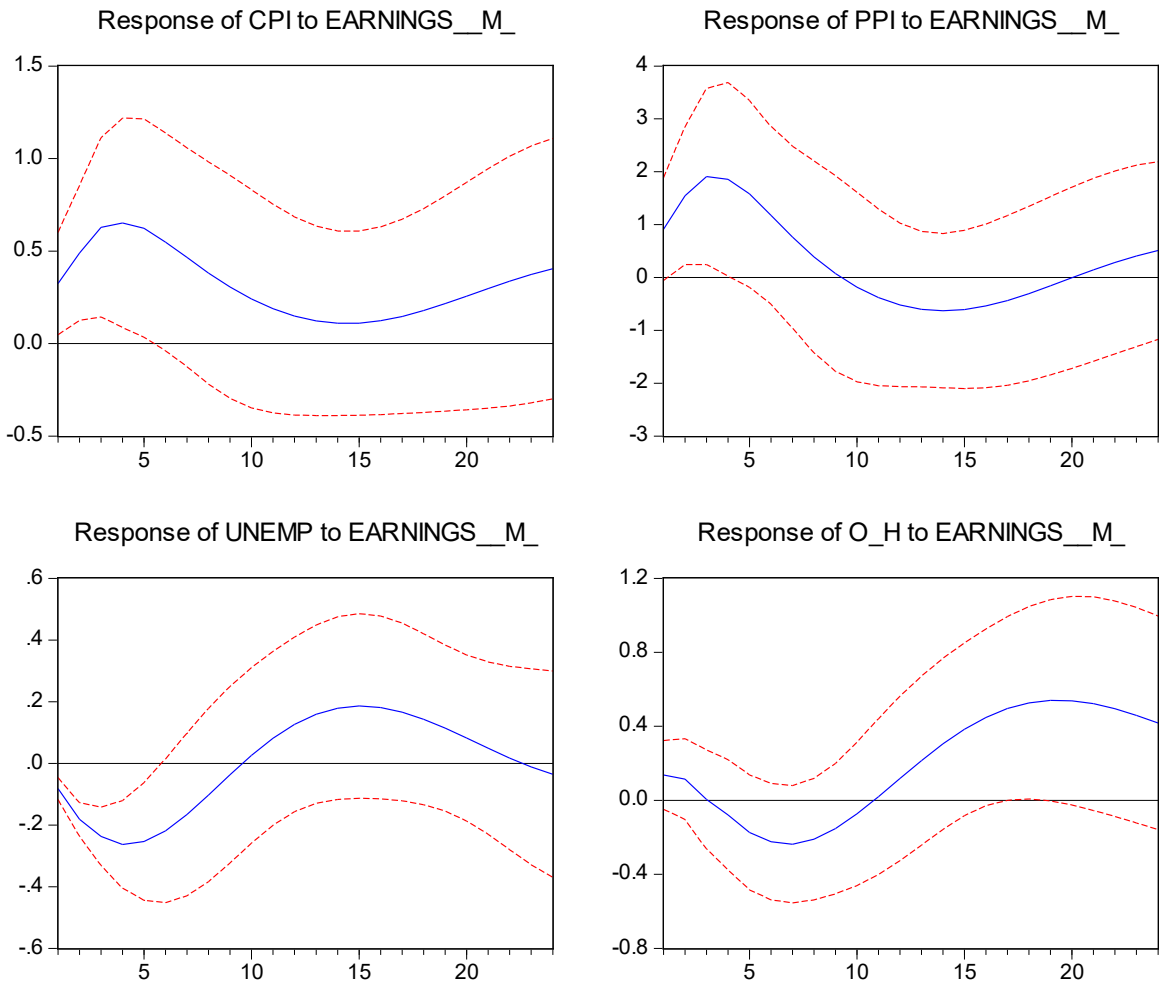
The impulse response measures the effects of variables on one another from a Cholesky One S.D. shock to the dependent variable. We looked at the effects in a 24 periods, or 6 year timeframe; this allows us to see how long the impact of the nominal shocks takes to dissipate. We can observe employee earnings' response to a shock on each of the dependent variables, and see how long it takes for employee earnings to return to equilibrium. The bootstrapped confidence bands to take into account 1 standard deviation estimation margin.

Figure 5: Response to Earnings Cholesky One S.D. Innovations



Source: Author's Compilation

Figure 6: Response of Unemployment, Inflation, and Labor Productivity from Cholesky One S.D. Innovations



By observing employee earnings response to unemployment we see a slight lag to where earnings starts to drop due to increased unemployment. The shock to earnings from unemployment dissipates after about 8 periods or 2 years. The short term effects that unemployment has on wage levels signify the lack of the long term relationship between unemployment and employee earnings. The response to a shock to earnings is an immediate drop in unemployment which takes around 9 periods to dissipate. This confirms our findings in the Granger Causality that Unemployment has a one directional causal relationship on earnings. Inflation shocks have a longer timeframe of disequilibrium when compared to unemployment.

We see a similar lag to when the inflation shock starts to affect employee earnings. The lag seen in producer prices' impact on earnings seems to last a little bit longer than the lag seen from a shock to the consumer price index. CPI seems to have a permanent long term increase seen from a shock to earnings, with the shock minimizing around 14 periods but never returning to equilibrium. As seen by the confidence bands this result could be a forecasting error that causes this long term relationship to exist. A shock to earnings greatly increases producer prices in the short run lasting roughly 9 periods. The strength of the response may be due to the fact that wages paid to workers is a significant cost that must be taken into account during the production process.

The shock caused by a change in labor productivity is the longest lasting of the shocks, showing that it takes nearly 20 periods or five years for the positive effects caused by productivity gains to dissipate. This structure differs from the reaction of wage levels to productivity shocks in Eriksson (2005) study on Swedish wage formation, took much longer to dissipate. One explanation for this might be the much higher degree of wage rigidity in Sweden. The strong bargaining power and participation from labor unions makes it much harder to lower wage levels. We see an immediate response in productivity to a shock in earnings, but this response dissipates within one year, roughly three periods. In theory the increase in earnings must motivate employees to become more productive in the short term.

5.0: Conclusions

While there are many trends that can be observed while looking at raw data that would suggest a simple linear relationship between these variables and nominal employee earnings we have discovered through our data that the relationships causality and direction is not as simple as it may seem. In running the Granger Causality test we were able to see which variables where dependent and how strong their predictive causality was.

Through running the Granger Causality Test we were able to determine that the relationship between Labor Productivity and Employee Earnings was one directional with Earnings Granger causing Labor Productivity. This tells us that employee earnings allow us to predict Labor Productivity but the inverse cannot be accepted. The same relationship holds true

between Employee Earnings and Unemployment, whereas Employee Earnings Granger causes Unemployment and can be used to predict Unemployment, and the inverse does not hold true. While Consumer and Producer inflation levels have a bidirectional relationship with Employee Earnings where, Inflation Granger causes Earnings, while Earnings also Granger causes Inflation. One relatively obvious observation made during the Granger Causality Tests, is the Unemployment's Granger causality over Labor Productivity. This is because Labor Productivity is measured by total output divided by total hours worked and with high unemployment we reduce the hours worked. This relationship allows us to predict changes in labor productivity based on unemployment data.

After running the impulse response as seen in Figure 5, we can observe that Earnings has a positive shock on Labor productivity which turns negative after about 4 periods or 1 year. Also both Inflation measures are affected by a shock in earnings as well as earnings being affected by a shock to inflation measures. Earnings respond to PPI and CPI with a negative effect which is maximized at 7 and 9 periods respectively. Also PPI and CPI are positively shocked by earnings and while PPI's positive shock disappears after about 10 periods CPI's positive shock is minimized around 15 periods, but never returns to 0 in the 24 period timeframe.

Our finding regarding Labor Productivity and Employee Earnings tells us that employee's do feel a short term sense of increased incentive when there is an increase in wages. Although Kumar et al. (2009) determined the relationship between wage levels and labor productivity to be a bidirectional in Australia in the long run, but not the short run. Therefore I expect my study may have not taken a long enough time frame into consideration to see this relationship develop. I believe we saw the one directional relationship do to the short term effects of productivity gain seen from a shock to wages in the impulse response. I conclude that wage increases do drive productivity in the short term, but I cannot determine if in the long run productivity has a causal relationship with wage levels.

When looking at Unemployment's effects on wage determination we see a one directional causal relationship with employee earnings causing unemployment. This is different than the findings of Jacobsen et al. (1998), a study done in Sweden, which found unemployment

to Granger cause wages. This offers us two different explanations for differences in these relationships, one being the different labor structures will cause different impacts on wages, and two the data was taken from a period of time in which the first 48 quarters of data had historically low and constant unemployment rates. However when we look at the impulse responses between unemployment and employee earnings we do see some similarities in the length of time it takes the shock to dissipate and the strength of the response seen by the shock, although one major difference is the lag seen on the response of earnings to a shock in unemployment, where a wage shock has an immediate shock on unemployment. I believe the slower response of wages may be due to the nature of the "stickiness" of wages. Where if there is suddenly higher paying jobs opened up there is nothing to stop a worker from applying for those jobs. Whereas, if we see a sudden jump in the national unemployment rate, we may see an employer be more reluctant to give a raise, but will rarely see a massive slashing of wages. I believe this "stickiness" of wages is what prevents unemployment rates, which fluctuate much more freely than wage levels, from being a good predictor of wage levels.

As for our inflation measures we can conclude several points from our tests on inflation's role in the wage determination process. Both producer and consumer prices, exhibit a bidirectional causal relationship with employee earnings. PPI and CPI shocks cause a lagged decrease in employee earnings that dissipated after about 14 and 16 periods respectively. While earnings shocks on PPI and CPI caused an immediate increase in both inflation measures. PPI's response to the shock dissipated after 9 periods, whereas CPI's response never returned to 0 although did minimize at around 14 periods. Wage levels as a whole has a stronger predictive capability to predict inflation, than inflation's ability to predict wages.

In the short run inflation is the best predictor of wage levels, while labor productivity and unemployment are poor predictors of short term wage levels. Wages may be a better predictor of CPI, PPI, unemployment and labor productivity, than they are a predictor of wages. When comparing the US wage determination process with that of Sweden and Australia we can see how in the US, which has a much less unionized workforce, wages are more strongly dependent on producer prices than other variables. This is largely in a highly unionized workforce wage bargaining is dependent of a wider range of variables which are used to argue for higher wages.

Appendix A: Variable Description and Data Source

Acronym	Variable Description	Source
EARNINGS__M_	Total aggregate for Nominal Employee Earnings for each hour worked.	Bureau of Labor Statistics (www.bls.gov)
CPI	Indexed basket of goods for the average urban consumer.	Bureau of Labor Statistics (www.bls.gov)
PPI	Indexed basket of goods for the average producer.	Bureau of Labor Statistics (www.bls.gov)
O_H	Total national output divided by total labor hours.	Bureau of Labor Statistics (www.bls.gov)
UNEMP	Percent of labor force unemployed	Bureau of Labor Statistics (www.bls.gov)

Appendix B: VAR Coefficients & (Standard Error)

Variable	Earnings	CPI	PPI	Unemployment	Labor Productivity
Earnings(-1)	1.844374 (0.19904)	0.923289 (0.86139)	2.579156 (3.00066)	-0.531184 (0.11826)	1.051044 (0.57055)
Earnings(-2)	-0.956143 (0.17789)	-1.054250 (.076985)	-3.815176 (2.68179)	0.589354 (5.57596)	-0.974808 (0.50992)
CPI(-1)	0.002276 (0.08231)	0.193981 (0.35624)	-1.074751 (1.24096)	-0.021211 (0.04891)	-0.138431 (0.23596)
CPI(-2)	0.079474 (0.07592)	1.066614 (0.32857)	2.760417 (1.14458)	-0.017830 (0.04511)	0.362288 (0.21763)
PPI(-1)	-0.010031 (0.02361)	0.212498 (0.10218)	1.244427 (0.35594)	0.011953 (0.01403)	0.036665 (0.06768)
PPI(-2)	-0.032772 (0.02175)	-0.335022 (0.09413)	-1.013355 (0.32792)	0.016559 (0.01292)	-0.152678 (0.06235)
Unemployment(-1)	-0.146019 (0.30226)	0.104004 (1.30813)	-1.589865 (4.55689)	0.676346 (0.17960)	2.615970 (0.86646)
Unemployment(-2)	-0.033551 (0.31228)	-0.461674 (1.35147)	-1.214659 (4.70788)	0.397278 (0.18555)	-2.146359 (0.89517)
Labor Productivity(-1)	0.034650 (0.04695)	0.136993 (0.20319)	0.047340 (0.70782)	-0.020829 (0.02790)	0.633091 (0.13459)
Labor Productivity(-2)	-0.049917 (0.04316)	-0.241007 (0.18678)	-0.712839 (0.65065)	0.013414 (0.02564)	0.183377 (0.12372)
C	8.664464 (5.19828)	3.505335 (22.4970)	63.29417 (78.3688)	-3.782829 (3.08870)	-12.74261 (14.9012)

Appendix C: Coefficient Summary

R-squared	0.997722	0.997547	0.975412	0.990585	0.997887
Adj. R-squared	0.997193	0.996977	0.969694	0.988395	0.997395
Sum sq. resids	2.488597	46.61068	565.6161	0.878589	20.44933
S.E. equation	0.240571	1.041138	3.626826	0.142942	0.689613
F-statistic	1883.536	1748.910	170.5832	452.4104	2030.241
Log likelihood	6.463476	-72.64951	-140.0438	34.57471	-50.40476
Akaike AIC	0.168019	3.098130	5.594216	-0.873137	2.274250
Schwarz SC	0.573183	3.503294	5.999379	-0.467974	2.679414
Mean dependent	130.9878	185.5604	147.1648	5.312963	126.7745
S.D. dependent	4.540328	18.93597	20.83353	1.326909	13.51141

Determinant resid covariance (dof adj.)	0.000692
Determinant resid covariance	0.000222
Log likelihood	-155.9157
Akaike information criterion	7.811692
Schwarz criterion	9.837509

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