Wage Phillips Curve in South Africa: A New Keynesian approach

Vincent Dadam* University of Pretoria

Nicola Viegi† University of Pretoria and ERSA

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Abstract

This paper studies the relationship between wage inflation and employment conditions in South Africa by estimating an aggregate New Keynesian Wage Phillips curve and by analysing wage formation at a sectoral level. First we estimate an aggregate model based on a New Keynesian model with staggered nominal wages setting where all variations in hired labour input are taking place at the extensive margin, using aggregate data from 1971 to 2013. The aggreagate estimations show that private sector nominal wages are not responsive to employment conditions, while they show a certain sensitivity to inflation and quite a good correlation with inflation expectations. In the second part of the paper we look at the relationship between nominal wage, productivity and the reservation wage, using a panel of nine industrial sectors over the period 1970- 2013. The findings confirm that nominal wage inflation has consistently outpaced the growth in productivity, even after correcting for inflation, and that employment conditions had little effects on wage dynamics. We also test for the possibility that the dynamic of wages is anchored by an underlined reservation wage to investigate the presence of an error correction in a wage equation for South Africa.

JEL codes: C71, C78, E52.

Keywords: Monetary Policy, Focal Points, Credibility, Optimal Band-Width.

*Corresponding author: dadamvince@yahoo.fr. Department of Economics, University of Pretoria, Tukkiewerf Building, Lynwood Road, 0002, Pretoria, South Africa

†nicola.viegi@up.ac.za, Department of Economics, University of Pretoria, Tukkiewerf Building, Lynwood Road, 0002, Pretoria, South Africa

1 Introduction

Unemployment is the defining characteristic of the South African economy. For the past 20 years the unemployment rate, in its narrow definition, has fluctuated around 25% without any significant and permanent reduction. Unemployment is largely young, unskilled and African and its dimension and persistence is a source of uncertainty and instability. The dimension of the problem has generated a large academic and political literature studying its determinants and characteristics (Benerjee et al, 2008, Bhorat, 2004, Casale et al, 2004). This literature see the rise of unemployment in South Africa as a combination of structural changes in labour demand, with an increase in capital intensity and skill biased technical progress, and institutional constraints on the labour supply side, especially downward rigidities of wages due to bargaining institutions and relatively high reservation wages.

What has been missing from the debate is an analysis of the consequences of these structural characteristics of the labour market at the business cycle frequencies. The South African economy response to the 2007 international financial crisis has given the strongest evidence yet of the relevance of the labour market in determining the response of the economy to external shocks. Just to give an indication of how peculiar the response of the South African economy to the financial crisis has been, figures 1 and 2 show the GDP and employment response to the financial crisis respectively of Germany, UK, South Africa and Chile.

Figure 1: GDP 2008-2013 of selected countries

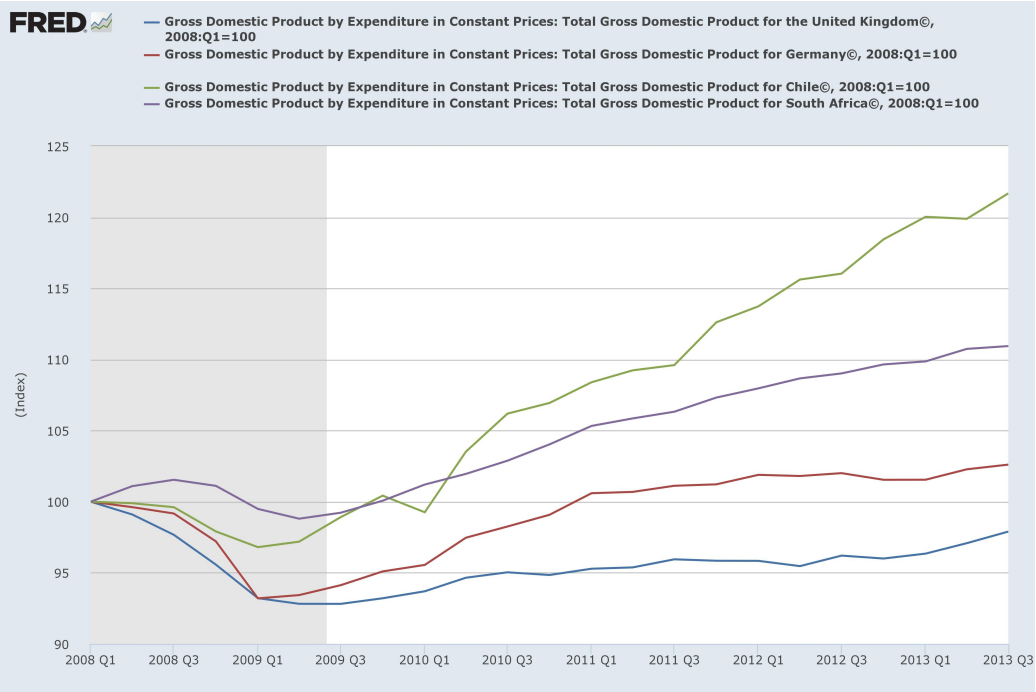
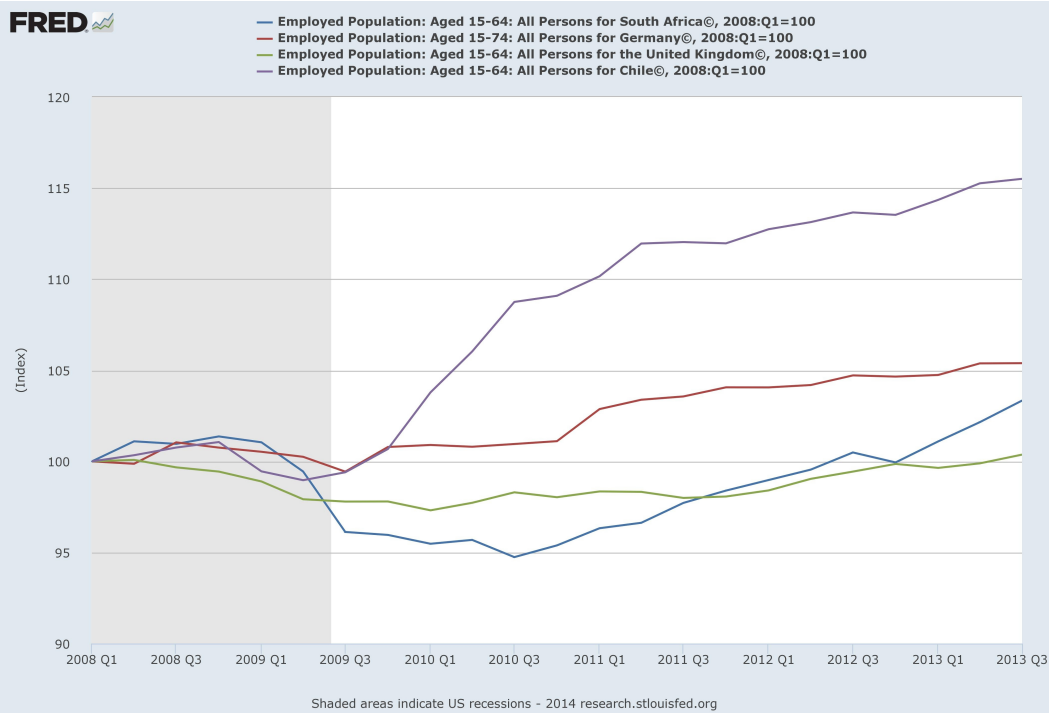
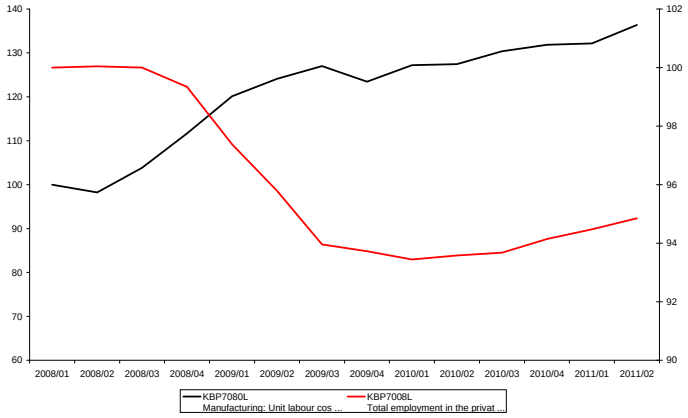


Figure 2: Employment 2008-2013 of selected countries



The shaded area represents the US recession period. South Africa has the best GDP performance after Chile, showing that the financial crisis had a limited impact on the South African economy. Instead the employment response has been dramatic and persistent, and much worse than any other country considered in the picture. The reason of this dismal employment performance can be found in the contemporaneous dynamic of the labour cost, which increased sharply at the beginning of the recession, as shown in figure 3

Figure 3



This event highlighted two issues in relation to the South African economy: the first issue is that while unemployment is a large structural phenomenon, there is a large dynamic of job destruction, and to a lesser extent of job creation, that needs to be understood more clearly if we want to dent the long term structural problem in a reasonable time. This has been already highlighted by the labour market literature, in particular Banerjee et al (2008) and Kerr et all (2013) in some preliminary work on the formal economy. The second issue, and the main theme of this paper, is that wages do not respond strongly to labour market conditions, which has important implications for the efficiency of monetary policy and the working of the inflation targeting regime.

The negative relation between the rate of changes of wages and the unemployment rate has been central to our intuition about the functioning of the economy at least from the seminal article of William Phillips on "The Relation between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861-1957" (Phillips, 1958). Although most of the subsequent work concentrated on the relationship between price inflation and unemployment in a NAIRU setting, recent New-Keynesian literature (for example Erceg, Anderson and Levin, 2000, Gali, 2013 and Gali and Monacelli 2013) has refocused our attention on the nominal wage-unemployment relationship and has shown that monetary policy efficiency depends critically on the responsiveness of wages and prices to changes in aggregate demand. A change in nominal wages affects employment because of its effect on firm marginal cost and, given the monopolistic competitive market structure, on price inflation. The inflationary effect of wage increases induces a contractionary monetary response, which causes a reduction of employment. The cost of adjustment will be higher the less sensitive are wage dynamics to demand conditions. Consequently if wages are very responsive to employment conditions, monetary policy can reduce inflationary pressures on the economy by a relatively small contraction in demand. On the other hand, if wages are not very responsive to demand condition, the potential sacrifice ratio of a contractionary monetary policy can be very significant.

The objective of this paper is to revaluate the relationship between nominal wage inflation and macroeconomic conditions using a New Keynesian framework, as developed by Gali (2013). We first present how a Wage Phillips curve can be derived from a model with staggered wage setting as in Erceg, Henderson and Levin (2000). We then estimate this version of the wage Phillips curve for South Africa to determine the responsiveness of wages to employment conditions and thus defining the "wage sacrifice ratio" characterizing the South African economy. In the final part we look at the wage formation at a sectorial level, linking wage formation with productivity and price determination of the firms. The overall picture illustrated by this exercise is of a wage formation mechanism that is weakly determined by both employment conditions and productivity dynamics, as previously noted by Klein (2012), with a significant reservation wage and exogenous wage determination, mainly driven by bargaining power and potentially the dominance of wage formation in the public sector.

2 The Model

Following Gali (2013) we use a staggered wage setting model, where labour is indivisible with all the changes in hired input taking place in the form of variations in employment.

A large representative household is composed by a continuum of members represented by the unit square and indexed by a pair $(i, j) \in [0, 1] \times [0, 1]$. The first dimension (indexed by $i \in [0, 1]$) represents the type of labour in which a given household member is specialised. The second dimension indexed by $j \in [0, 1]$) defines his/her disutility from work. This disutility is given by $\chi_t j^{\varphi}$ if he/she is employed, zero otherwise. $\varphi \geq 0$, defines the elasticty of the marginal disutility of work and $\chi_t > 0$ is an exogenous preference shifter which we also refer to as a labour supply shock given the impact it has on labour supply.

The utility is logarithmic in consumption and there is full risk sharing among household members. Therefore, the household period utility corresponds to the integral of its members' utilities and is given by:

$$\begin{aligned} U(C_t, \{N_t(i)\}, \chi_t) &\equiv \log C_t - \chi_t \int_0^1 \int_0^{N_t(i)} j^{\varphi} dj di \\ &= \log C_t - \chi_t \int_0^1 \frac{N_t(i)^{1+\varphi}}{1+\varphi} di, \end{aligned}$$

where C_t denotes household consumption and $N_t(i)$ is the fraction of members specialised on type i labour who are employed in period t.

The household seeks to maximise

$$E_0 \sum_{t=0}^{\infty} \beta^t U(C_t, \{N_t(i)\}, \chi_t)$$

subject to the following budget constraint

$$P_t C_t + Q_t B_t \leq B_{t-1} + \int_0^1 W_t(i 0 N_t(i) di + \Pi_t \tag{1}$$

where we define P_t as the price of the consumption bundle, $W_t(i)$ is the nominal wage for labour of type i, B_t denotes purchases of a nominally riskless one-period bond at a price Q_t, and Π_t is a lumpsum component of income which may include dividends from ownership of firms.

Assuming the formalism of Calvo (1983) that the model by Erceg, Henderson and Levin (2000) follows, workers supplying a labour service of specific type get to reset their nominal wage with probability $1-\theta_w$ each period. This probability is independent across labour types. In addition, it is not affected by the time that has gone by since last the wage was reset. Another fraction of workers θ_w keep their wage unchanged in any given period. We therefore define the parameter θ_w as the natural index of nominal

wage rigidities. Once the wage has been set, the quantity of workers employed is determined unilaterally by firms, with households willingly meeting that demand by sending its specialised workers with the lowest work disutility. It is important to note however that the wage remains above the disutility of work for a marginal worker.

Workers reoptimise their wage in period t choosing a wage W_t^* that maximises the household utility as opposed to their own individual utility, subject to a sequence of isoelastic demand schedules for their labour type and the usual sequence of household flow of budget constraint. The following first order condition is therefore derived and written as

$$\sum_{k=0}^{\infty}(\beta\theta_w)^k E_t\left\{\frac{N_{t+k|t}}{C_t}\left(\frac{W_t^*}{P_{t+k}}-\mathcal{M}^w MRS_{t+k|t}\right)\right\}=0$$

where $N_{t+k|t}$ denotes the quantity demanded in period $t+k$ of a labour type whose wage is being reset in period t, $MRS_{t+k|t} \equiv \chi_{t+k}C_{t+k}N_{t+k|t}^{\varphi}$ is the relevant marginal rate of substitution between consumption and employment in period $t+k$, and finally $\mathcal{M}^w \equiv \epsilon_w/(\epsilon_w-1)$ is the desired or flexible wage markup, with ϵ_w denoting the constant wage elasticty of demand for services of each labour type.

After log-linearising the above optimality condition around a zero inflation steady state, and using lower case letters to denote the log of the corresponding variable, we get the following approximate wage setting rule

$$w_t^* = \mu^w + (1-\beta\theta_w)\sum_{k=0}^{\infty}(\beta\theta_w)^k E_t\left\{mrs_{t+k|t}+p_{t+k}\right\} \tag{2}$$

where $\mu^w \equiv \log \mathcal{M}^w$.

In the absence of nominal rigidities ($\theta_w = 0$) we have $w_t^* = w_t = \mu^w + mrs_t + p_t$, implying a constant markup μ^w of the wage w_t over the price-adjusted marginal rate of substitution, $mrs_t + p_t$. When nominal rigidities are present on the other hand, new wages are set as a constant markup μ^w over a weighted average of current and expected future price-adjusted marginal rates of substitution.

If we let $mrs_t \equiv c_t + \varphi n_t + \xi_t$ denote the economy's average log marginal rate of substitution, where $\xi_t \equiv \log \chi_t$, we can write

$$mrs_{t+k|t} = mrs_{t+k} + \varphi(n_{t+k|k} - n_{t+k}) = mrs_{t+k} - \epsilon_w\varphi(w_t^* - w_{t+k}) \tag{3}$$

Now by log-linearising the expression for aggregate wage index around a zero inflation steady state we obtain,

$$w_t = \theta_w w_{t-1} + (1-\theta_w)w_t^* \tag{4}$$

By combining (1) and (4) following Erceg, Henderson and Levin (2000) we can derive the baseline wage inflation equation

$$\pi_t^w = \beta E_t \left\{ \pi_{t+1}^w \right\} - \lambda_w (\mu_t^w - \mu^w) \tag{5}$$

where $\pi_t^w \equiv w_t - w_{t-1}$ denotes wage inflation, $\mu_t^w \equiv w_t - p_t - mrs_t$ is the average wage markup and $\lambda_w \equiv \frac{(1-\theta_w)(1-\beta\theta_w)}{\theta_w(1+\epsilon_w\varphi)} > 0$.

Wage inflation therefore depends positively on expected one period ahead wage inflation and negatively on the deviation of the average wage markup from its desired value. By solving (5) forward, we obtain

$$\pi_t^w = -\lambda_w \sum_{k=0}^{\infty} \beta^k E_t \left\{ \left(\mu_{t+k}^w - \mu^w \right) \right\} \tag{6}$$

which means that wage inflation is proportional to the discounted sum of expected deviations of current and future average wage markups from their desired levels. More intuitively, if average wage markups are below their desired level, workers that have a chance to reset their wage will tend to adjust it upward thus generating positive wage inflation, and *viceversa*.

In the literature, the estimated version of the above generally allow for automatic indexation to price inflation of the wages that are not reoptimised in any period. However, following Gali(2011) we assume the following indexation rule

$$w_{t+k|t} = w_{t+k-1|t} + \gamma \overline{\pi}_{t+k-1}^p + (1-\gamma)\pi^p + g \tag{7}$$

for $k = 1, 2, 3...$, where $w_{t+k|t}$ denotes the period $t+k$ log wage for workers who last reoptimised their wage in period t (with $w_{t|t} \equiv w_t^*$), $\overline{\pi}^p$ is the measure of price inflation to which wages are indexed, π^p is the steady state price inflation, and g is the rate of growth of productivity (and real wages) in the steady state. In that case the following wage inflation equation can be derived

$$\overline{\pi}_t^w - \gamma \overline{\pi}_{t-1}^p = \alpha + \beta E_t \left\{ \pi_{t+1}^w - \gamma \overline{\pi}_t^p \right\} - \lambda_w \left(\mu_t^w - \mu^w \right) \tag{8}$$

where $\alpha \equiv (1-\beta)((1-\gamma)\pi^p + g)$.

2.1 Extension of the model

By taking current labour market conditions as given and using household welfare as a criterion, a household member will find it optimal to participate in the labour market in period t if and only if

$$\frac{W_t(i)}{P_t} \geq \chi_t C_t j^{\varphi}$$

The real wage prevailing in the worker's trade must be above his/her disutility from working (expressed in terms of consumption).

Thus the marginal supplier of type i labour denoted by $L_t(i)$, is implicitly given by

$$\frac{W_t(i)}{P_t} = \chi_t C_t L_t(i)^{\varphi}$$

By taking the log and integrating over i, we obtain

$$w_t - p_t = c_t + \varphi l_t + \xi_t \tag{9}$$

where $l_t \equiv \int_0^1 l_t(i)di$ denotes the model's implied aggregate participation or labour force, $w_t \equiv \int_0^1 w_t(i)di$ is defined as the average wage.

We now move on to define the unemployment rate u_t as

$$u_t \equiv l_t - n_t \tag{10}$$

Combining (9) and (10) with the expression for the average wage markup given by $\mu_t^w \equiv (w_t - p_t) - (c_t + \varphi n_t + \xi_t)$ and we obtain the following linear relationship between the wage markup and the unemployment rate

$$\mu_t^w = \varphi u_t \tag{11}$$

We define the natural rate of unemployment, u_t^n, as the rate of unemployment that would prevail in the absence of nominal wage rigidities. Therefore assuming a constant desired wage markup, it follows that u_t^n is constant and given by

$$u^n = \frac{\mu^w}{\varphi} \tag{12}$$

Therefore, the unemployment is a consequence of worker's market power (the wage being above their perfectly competitive level).Unemployment fluctuations on the other hand result from the slow adjustment of wages.

By combining (5), (11) and (12), we obtain the following New Keynesian Phillips Curve

$$\pi_t^w = \beta E_t \left\{\pi_{t+1}^w\right\} - \lambda_w \varphi (u_t - u^n) \tag{13}$$

By combining equations (8) and (11) we obtain the following augmented New Keynesian Wage Phillips Curve

$$\pi_t^w = \alpha + \gamma \overline{\pi}_{t-1}^p + \beta E_t \left\{\pi_{t+1}^w - \gamma \overline{\pi}_t^p\right\} - \lambda_w \varphi \left(u_t - u^n\right) \tag{14}$$

It is important to note that even though equation (13) shows a relationship between wage inflation and the unemployment, it differs from the original Phillips Curve First off, equation (13) is a microfounded

structural relationship between wage inflation and unemployment. Therefore, the steepness of the slope of equation (13) is decreasing in wage rigidity to the point that as wage approaches full flexibility, the curve becomes vertical. Secondly, equation (13) defines wage inflation as a forward looking variable which is in contrast with the static and contemporaneous nature of the original Phillips curve in which expectations play no role.

Next we turn to define a reduced form representation for the New Keynesian Wage Phillips Curve which we intend to estimate using South Africa data. By assuming that unemployment follows a stationary AR(2) process, we can formally write

$$\widehat{u}_t = \phi_1 \widehat{u}_{t-1} + \phi_2 \widehat{u}_{t-2} + \varepsilon_t \tag{15}$$

where $\widehat{u}_t = u_t - u^n$ and ε_t is white noise. By combining (15) and (14) we obtain the following wage inflation

$$\pi_t^w = \alpha + \gamma \overline{\pi}_{t-1}^p + \psi_0 \widehat{u}_t + \psi_1 \widehat{u}_{t-1} \tag{16}$$

where $\psi_0 \equiv -\frac{\lambda_w \varphi}{1-\beta(\phi_1+\beta\phi_2)}$ and $\psi_1 \equiv -\frac{\lambda_w \varphi \beta \phi_2}{1-\beta(\phi_1+\beta\phi_2)}$

Equation (16) is therefore the equation we turn to estimate using South Africa's data. We later compare the results to the findings of Gali (2011).

3 Empirical results

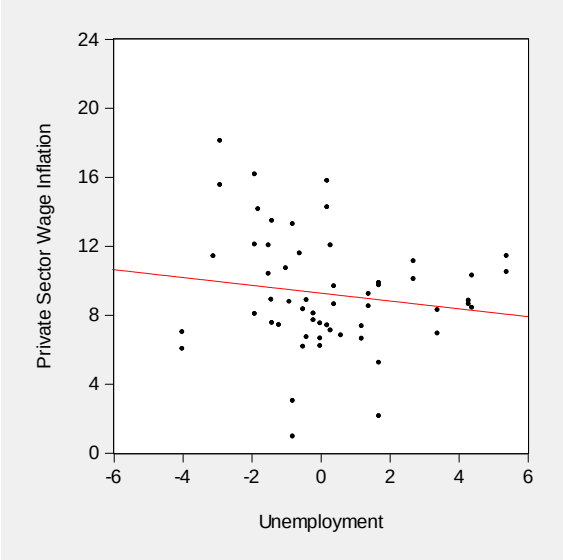
3.1 Data

Labour market data in South Africa are notoriously not very reliable and subjected to extensive change in definition. We use a large set of different variables and different definitions of labour market conditions. Our quarterly data covers the period 1970Q1-2013Q4. We use a large set of different variables and different definitions of labour market conditions. The baseline specification includes the consumer price index as a measure of price inflation and two alternative sources of wage data namely the remuneration in the private sector excluding non-agricultural sectors and unit labour costs in the manufacturing. Wage inflation is measured as the centered four quarters difference of the log nominal wage expressed in percentage terms. The same applies for price inflation. The cyclical unemployment measure, as difference from the mean, is really usable only from 2000Q1 to 2014Q1. To have a longer specification we need to substitute the unemployment measure with more reliable employment measures, in particular private sector employment and manufacturing employment. The private sector employment has gone through a series of revisions and the data are not always comparable through time. Nevertheless we try statistically to reduce the effect of these distortions. Manufacturing employment is the most reliable measure, but

it is only a proxy of the overall labour market conditions. The employment variables are de-trended using the Hodrick-Prescott filter to analyse variable employment as its deviation from the steady state value, while the unemployment series is demeaned of the average value of 25 per cent unemployment rate, that implicitly we assume is the natural rate of unemployment. Data sources include the South African Reserve Bank, Quantec and the Saint Louis Federal Reserve Bank database.

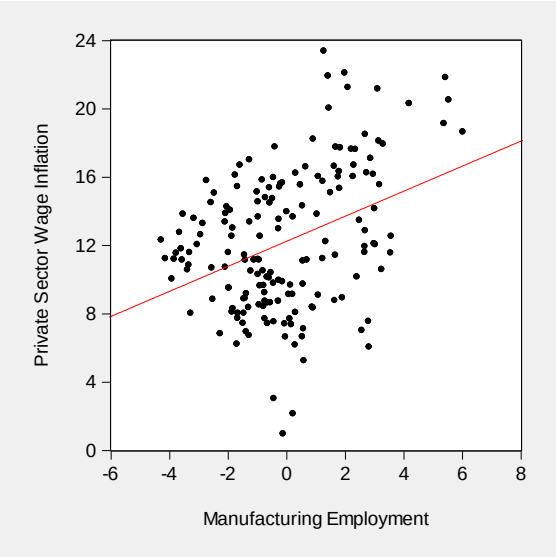
Before introducing the regression analysis, it is worth having a quick look at the data to be used in the specification (16). The basic hypothesis common with the old Phillips curve specification, is that there is a negative relationship between wage inflation and unemployment. In figure 4 we display this relationship for the period 2000-2014. We show two scatter plots of wage inflation and unemployment to check if such relationship applies in the case of South Africa.

Figure 4: Private sector wage inflation and unemployment



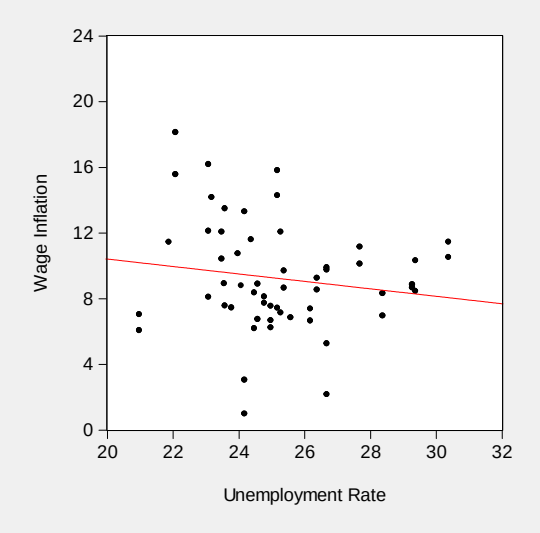
The relationship appears immediately to be quite weak. This could be due to the specific definition of unemployment used in South Africa. As argued by Banerjee (2008), a lot of the changes in the employment rate observed are counted for by change in labour participation rate. Thus a positive relationship between wage inflation and employment rate could be more revealing. Figure 5 shows the relationship between wage inflation and manufacturing employment between 1971 and 2014.

Figure 5: Private sector wage inflation and manufacturing employment



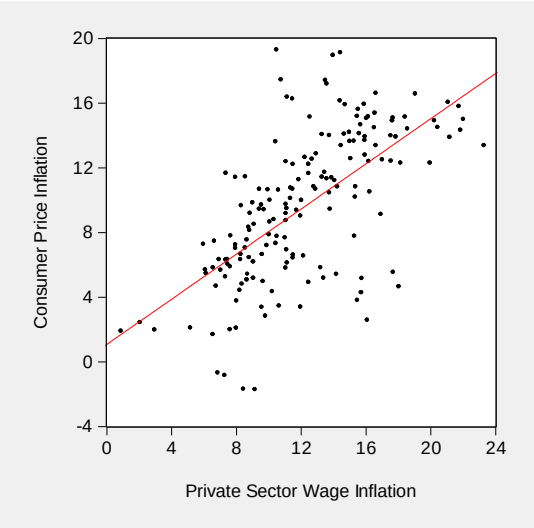
The positive relationship between wage inflation and employment seems much more promising, as is the relationship between wage inflation and total private employment. Less promising is the same relationship once viewed from the point of view of the inflation targeting period 2000-2014, in figure 6.

Figure 6: Wage inflation and unemployment 2000-2013



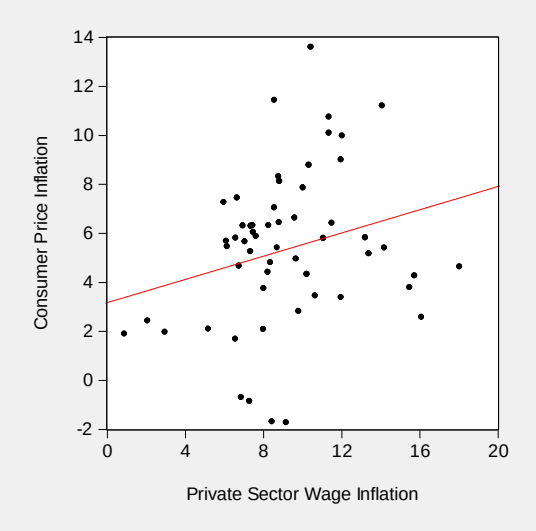
The final relationship in equation (16) is the one between wage inflation and price inflation. Historically the relationship appears very strong, as shown below

Figure 7: CPI inflation and private sector wage inflation



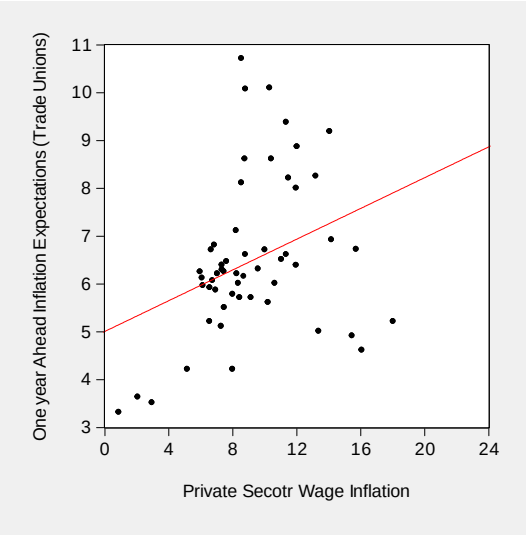
The relationship appears to weaken during the inflation targeting period, which is to be expected if monetary policy tries to insulate the overall price level from a change in the relative price of labour.

Figure 8: CPI inflation and private sector wage inflation 2000-2013



On the other hand there seems to be a strong correlation between wage inflation and inflation expectations of trade unions as recorded by the Bureau of Economic Research (BER), a fact that gives some indication that controlling inflation expectation might still be the most direct way to control wage dynamics.

Figure 9: One year ahead trade unions inflation expectations and private sector wage inflation



3.2 Estimation results

We report in the tables below OLS estimates of several specifications of the New Keynesian Wage Phillips Curve, each specification is a restricted version of equation (16). The standard errors are reported in brackets. In table 1, column 1 and 2 reports the traditional Phillips curve relationship between employment and wage inflation, for the whole sample in column (1) and for the post-apartheid sub-sample in column (2). In column (3) and (4) we report the results of introducing past inflation in the specification and finally in column (5) and (6) we report the full specification of equation (16). The relationship between wage inflation and employment is clearly weak and getting weaker in the most recent sample. Nominal wage and inflation have a strong and robust relationship which also is quantitative weaker in the second sample.

Table 1: Estimated wage inflation: private sector wage

	(1)	(2)	(3)	(4)	(5)	(6)
	$1970-2014$	$1994-2014$	$1970-2014$	$1994-2014$	$1970-2014$	$1994-2014$
n_t	0.19^{***} (0.05)	0.07 (0.04)	0.13^{**} (0.04)	0.06 (0.04)	0.18^{**} (0.05)	0.11^{*} (0.05)
n_{t-1}					-0.07 (0.05)	-0.06 (0.05)
π_{t-1}			0.55^{***} (0.05)	0.25^{*} (0.12)	0.56^{***} (0.05)	0.27^{**} (0.12)

***denotes significance at the 1% level, ** at the 5% level and * at the 10% level.

The result is largely confirmed if a different measure of change in wage is used. In table 2 we use the nominal unit labour cost inflation as measure of wage changes, which has the advantage to separate the change in wages from contemporaneous changes in productivity. The results are actually more robust,

and there is a stronger relationship between labour cost and employment conditions, even tough this relationship seems to become weaker in the second sample.

Table 2: Estimated wage inflation: unit labour costs

	(1)	(2)	(3)	(4)	(5)	(6)
	$1970-2014$	$1994-2014$	$1970-2014$	$1994-2014$	$1970-2014$	$1994-2014$
n_t	0.36^{***} (0.07)	0.23^{***} (0.05)	0.28^{***} (0.05)	0.23^{***} (0.05)	0.39^{***} (0.07)	0.31^{***} (0.07)
n_{t-1}					-0.15^{**} (0.06)	-0.12^{***} (0.07)
π_{t-1}			0.74^{***} (0.07)	-0.04 (0.15)	0.75^{***} (0.07)	0.02^{***} (0.15)

***denotes significance at the 1% level, ** at the 5% level and * at the 10% level.

If we consider only the inflation targeting period, we can use the official measure of unemployment to run the canonical Phillips curve relationship. Table 3 presents these results.

Table 3: Estimated Wage inflation: private sector wage

	(1)	(2)	(3)
	$2000-2014$	$2000-2014$	$2000-2014$
u_t	-0.31 (0.20)	-0.33^{*} (0.19)	-0.06 (0.34)
u_{t-1}			-0.25 (0.34)
π_{t-1}		0.24^{**} (0.13)	0.23^{**} (0.13)

***denotes significance at the 1% level, ** at the 5% level and * at the 10% level.

The results are consistent with the previous analysis. The relationship between wage inflation and unemployment is significant only when inflation is added to the specification. The insignificance of the third specification is probably due to the fact that the correct specification for the unemployment rate is a stationary AR(1) model and not the assumed AR(2). Using this result, we finally substitute the inflation rate with the observed expected inflation of the trade unions as recorded by the BER. Table 4 shows that this specification fits the data much better, highlighting the increasing importance of inflation expectations in the determination of wage inflation under the inflation targeting regime.

Table 4: Estimated Wage Inflation

	(1)	(2)	(3)
	$E\pi_t$	$E\pi_{t+1}$	$E\pi_{t+2}$
u_t	-0.37^{**} (0.18)	-0.35^{**} (0.19)	-0.37^{**} (0.18)
$E\pi$	0.73^{***} (0.23)	0.72^{***} (0.26)	0.82^{***} (0.29)
	2000Q3 - 2013 Q4		

***denotes significance at the 1% level, ** at the 5% level and * at the 10% level.

In all cases, the analysis of the residual shows that wage inflation was particularly high just before and during the financial crisis, moderating only after 2010. Overall the estimations imply a significant wage rigidity relative to either employment or unemployment conditions with a certain sensitivity to inflation and inflation expectations.

4 A sectoral analysis of nominal wage responsiveness to employment conditions

4.1 A simplified model

So far we have dealt with the response of nominal wage to labour market conditions at an aggregate level. In this section we continue our investigation at a sectoral level this time as we include labour productivity as a variable given the reservation wage.

Macroeconomic evidence shows a negative relationship between the rate of change of wages and unemployment. As mentioned earlier, this relationship is represented by a textbook Phillips curve of the following form:

$$(w_t - w_{t-1}) = a_w + (p_{t-1} - p_{t-2}) - \beta u_t + \epsilon_t \tag{17}$$

where p and w are respectively logarithms of the price level and nominal wage, u is the unemployment rate, a_w is a constant and ϵ is an error term. We assume as usual that the lagged inflation term given by $(p_{t-1} - p_{t-2})$ is a proxy for expected current inflation which we may write also write as $(p_t^e - p_{t-1})$. After reorganising, equation (17), it takes the following familiar form.

$$(w_t - p_t^e) = a_w + (w_{t-1} - p_{t-1}) - \beta u_t + \epsilon_t \tag{18}$$

In essence, the empirical wage equation implies that the expected log real wage depends on the lagged log of real wage and the unemployment rate. Intuitively, a low unemployment rate leads to an increase in the expected real wage, and *vice-versa*.

However, most theories of the natural rate of unemployment imply in contrast a negative relationship between the level of wages and unemployment if both the reservation wage and the level of productivity are taken into account. Such a wage curve (Blanchflower & Oswald, 1994, Blanchard & Lawrance, 1997) indicates that given the reservation wage, the tighter the labour market, the higher the real wage. Under some simplifying assumptions, models of efficiency wage (Shapiro, 1984) or bargaining (Mortensen & Pissarides, 1994) deliver a representation of a wage relation of the following form:

$$(w_t - p_t^e) = \mu b_t + (1 - \mu) y_t - \beta u_t + \epsilon_t \tag{19}$$

where b_t is the log of reservation wage, y_t is the log of productivity and μ is a parameter ranging from 0 to 1 The above relationship simply means that the expected real wage depends on both the reservation wage - which is the wage if unemployed - and on the level of productivity.

A quick look at the wage Phillips curve (equation 18) and the theoretical wage relation nested in equation (19) reveals two striking differences. First off, the reservation wage and the level of productivity are absent in the wage Phillips curve but present in the wage curve. Second and as stated earlier, the Phillips curve shows the relation between the change in real wage and unemployment whereas the theoretical wage curve is the relation between the level of real wage and unemployment given the reservation wage and the level of productivity. We now turn to discuss the determinants of the reservation which will help establish the conditions under which the wage Phillips curve and the theoretical wage relation can be reconciled.

Given that the reservation wage by definition is the wage an individual receives when unemployed, it therefore depends first of all on the generosity of unemployment benefits and other forms of support the same unemployed individual can expect to receive if jobless. Therefore, it follows that the institutional dependence of unemployment benefits on previous wages suggest that the reservation wage will move with lagged wages. It seems logical then to assume that workers' aspirations in job search and wage bargain would very be likely shaped by previous earnings. Further, Blanchard and Katz (1999) argue that the reservation wage depends on the utility of leisure, in other words what an unemployed individual does with his/her time. The utility of leisure may include home production and earning opportunities in the informal sector. Consequently, increases in productivity in the informal market economy and home production are closely related to those in the formal sector. Finally, the reservation wage depends also on non labour income. Thus, productivity increases lead to equal proportional increases in labour and non labour income.

It therefore seems logical to assume that the reservation wage depends on both productivity and lagged wages. Following Blanchard and Katz (1999) and for the sake of simplicity, we may write

$$b_t = a + \lambda(w_{t-1} - p_{t-1}) + (1 - \lambda)y_t \tag{20}$$

where a is a constant and λ is a parameter lying between 0 and 1. By substituting this expression for the reservation wage in the wage relation given by equation (19), we obtain:

$$(w_t - p_t^e) = \mu a + \mu\lambda(w_{t-1} - p_{t-1}) + (1 - \mu\lambda)y_t - \beta u_t + \epsilon_t \tag{21}$$

Looking at the above equation, it appears the theoretical wage relation (19) is consistent with the Phillips curve representation (18) if and only if $\mu\lambda = 1$. In other words, the wage relation and the Phillips curve specifications can be reconciled only if the following two conditions are simultaneously satisfied:

(a) first there is no direct effect of productivity on wages given the reservation wage ($\mu = 1$) and (b) second, there is no direct effect of productivity on the reservation wage ($\lambda = 1$). Although extreme, these two conditions cannot be ruled out. As a matter of fact, the strong performance of a standard wage Philips curve specification on US data suggests that $\lambda\mu = 1$ may be a reasonable approximation for the United States. The same cannot be said for the European market economy - and the South African economy for that matter. The striking difference between the empirical wage unemployment relations in the United States and Europe is a well known fact. In the present case however, the presence of an error correction term in the European but not the US wage equation is at the core of the debate. We suspect the same error correction term may be present in the South African wage equation as well. The question for debate is however, what is the magnitude of that error correction term?

Before indulging into the discussion about the differences between the three economies, lets begin by rewriting equation 21:

$$(w_t - w_{t-1}) = \mu a + (p_t^e - p_{t-1}) - (1 - \mu\lambda)(w_{t-1} - p_{t-1} - y_{t-1}) + (1 - \mu\lambda)\Delta y_t - \beta u_t + \epsilon_t \qquad (22)$$

Wage inflation depends on expected inflation, the unemployment and an error correction term defined as the difference between the lagged real wage and lagged productivity. An estimation of equation (22) shows that the coefficient on the error correction term for the US labour market is close to zero with point estimates that are wrong signed, small and insignificant. On the other hand, in most European countries and various OECD countries, the error correction term comes in with a significant and right signed coefficient which is on average around 0.25. Blanchard and Katz discuss what could possibly explain the difference between European and US labour markets.

Intuitively, the difference between the labour markets lies on the direct effect of productivity on wages ($1 - \mu = 0$ for the US and $1 - \mu > 0$ for Europe) and the direct effect of productivity on reservation ($1 - \lambda = 0$ in the US and $1 - \lambda > 0$ in Europe). This simply means that firstly, in Europe as well as in South Africa, unions play a greater role in wage settings. Further, stringent hiring and firing regulations in Europe may cause wage setting to behave differently compared to the US. This therefore provides evidence that productivity has more pronounced and direct effects on wages in Europe than in the US (Abowd, Kramarz, Margolis & Troske, 1998). Secondly, the importance of the underground economy for the unemployed in Europe may also be a significant factor to take into account to differentiate the two labour markets.

Given these two arguments, one may come to the conclusion that the South African labour market may be similar to the European one given the similarities. In fact, South Africa labour informal sector is quite significant to be left out when conducting empirical study. Furthermore, the bargaining power of workers' unions is considerable. This therefore provides motivation of investigating whether or not there exists an error correction term for South Africa as well. Moreover, we also investigate the relationship

between productivity and wage inflation.

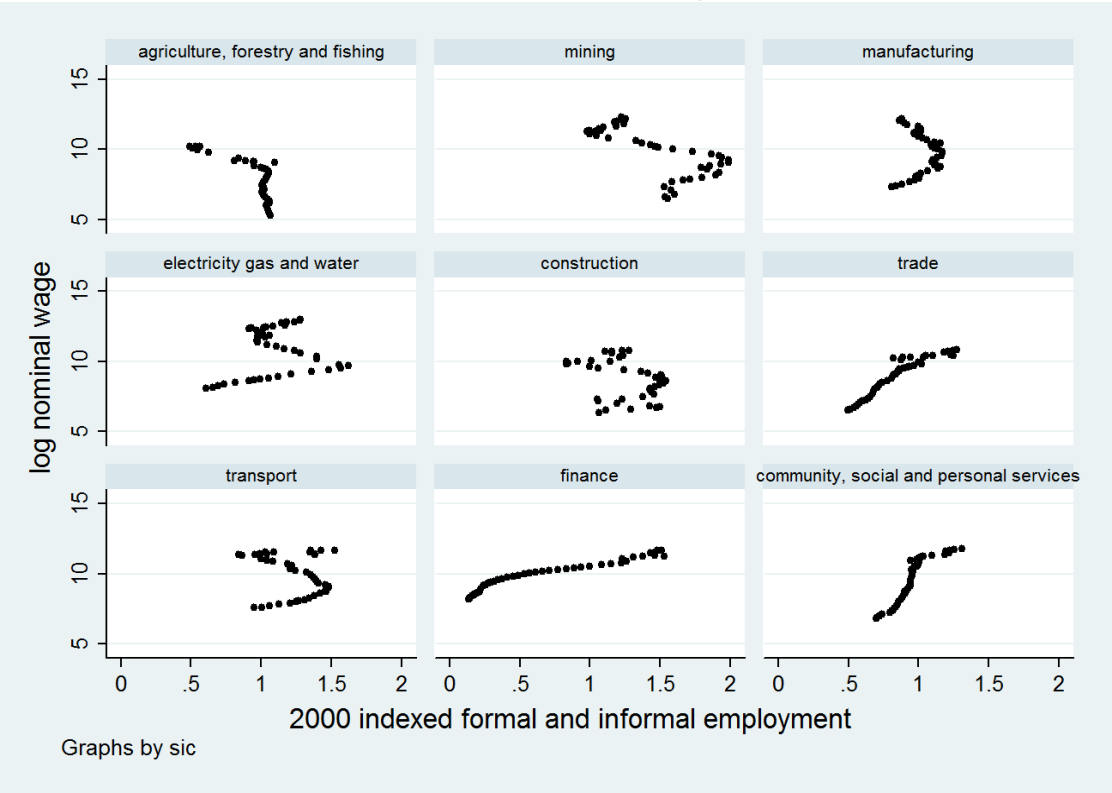
4.2 Empirical Study

4.2.1 Data

We use a panel of nine industrial sectors including: agriculture, forestry and fishing, mining, manufacturing, electricity, gas and water, construction, trade, transport, finance, and community, social and personal services. The annual data covers the period 1970 to 2013. Nominal wage is captured by the nominal remuneration per employee by sector. We use output price by sector as a measure of variable price whereas, and for the same reasons mentioned earlier, we rely on 2000 indexed employment data. We take into account both formal and informal employment per sectors. Finally productivity is captured by the 2005 indexed labour productivity per sector.

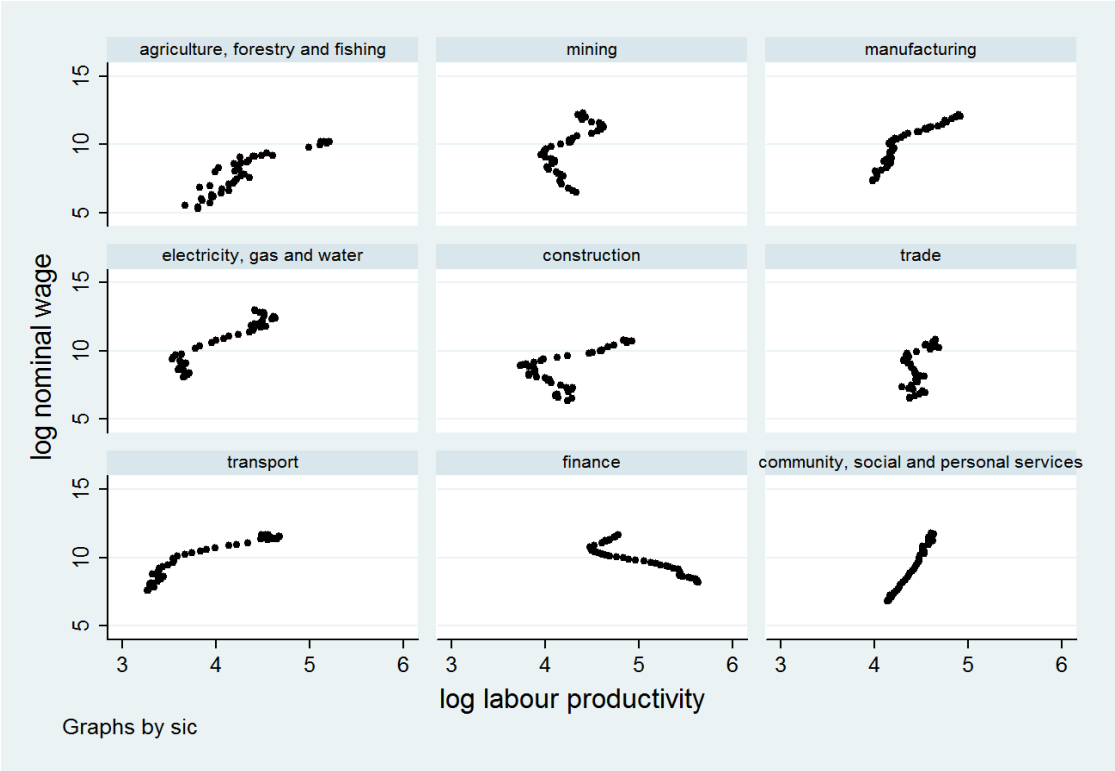
Before discussing the empirical results, lets begin by having a quick look a the data.

Figure 10: Nominal wage and employment



The correlation between nominal wage and employment appears positive throughout, although the relation is weak and relatively inconclusive especially in the case of the agriculture, forestry and fishing sector. We observe a strong positive correlation for the trade and community, social and personal services (public) sectors.

Figure 11: Nominal wage and productivity



According the economic theory, the growth in wages is determined by labour productivity which therefore reflect in an increase in the standard of living in the long run. The relationship between the two variables is mediated by the labour's share of output and the labour's terms of trade, i.e. the price of output relative to the price of goods that are consumed by workers (Sharpe, Arsenault and Harrison, 2008). In our sample however, the correlation between wages and labour productivity appears quite weak and positive across the sectors. This could be explain by the rising of earning equalities, and to some extend, by measurement issues. Also we cannot rule out the increase in output prices relative to the price of goods workers purchase in the markets. The sector that caught our attention however is the community, social and personal services (public) sector. In fact we observe a strong positive correlation between wages and labour productivity.

4.2.2 Empirical results

We estimate our model using pool mean group estimation which is suitable for nonstationary heterogenous panels. We essentially investigate the existence of a long run relationship between nominal wages, output price and labour productivity. We also explore the possibility of the presence of an error correction term as mentioned early for the South African economy. Variables in the short run includes nominal wage, output price, productivity and employment in both formal and informal sectors. The overall results are reported in the table below.

Table 5: Pool mean group estimates

$D.\ln nw$	
lnp	0.95^{***} (0.018)
$\ln prod$	0.97^{***} (0086)
SR	
ec	-0.113^{***} (0.028)
$D.\ln p$	0.301^{***} (0.075)
$D.\ln prod$	0.363^{***} (0.097)
$D.empif$	-0.326^{***} (0.057)

***denotes significance at the 1% level

'D' denotes the first difference. $\ln nw$: log nominal wage; $\ln prod$: log labour productivity, $\ln p$: log output price; $empif$: 2000 indexed formal and informal employment; SR: short run; ec: error correction term

Our prior expectation of the presence of an error correction term in the wage equation for South Africa is confirmed. The coefficient is right signed and significant but is however lower than the finding of Blanchard and Katz (1999) of 0.25 for the European market. This put the South African market somewhere in between the US and Europe meaning that productivity does affect wage directly and the reservation as well in South Africa, all these however to a lesser extend than it does in Europe countries. In the long run we find the coefficients on price and productivity to be very close to 1 which is also in line with prior expectations. In the short run on the hand, these coefficients are quantitatively smaller but remain significant. Employment is negatively and significantly correlated to nominal wages. Therefore an increase in wages is matched by a decrease in employment. Firms in these industries are typically faced by fixed wage and output price. Consequently, the only variable adjustable is the number of hired people. If the wage imposed is too high, the firms thus respond by releasing personnel.

The table below shows the pool mean estimates by industrial sectors.

Table 6: Pool mean group estimates per sectors

$D.\ln nw$	Agr.	Min.	Man	El	Cost	Tra	Tsp	Fin	Com
SR									
ec	-0.165^{**} (0.061)	-0.231^{***} (0.038)	-0.143^{**} (0.061)	-0.166^{**} (0.077)	-0.112^{*} (0.064)	-0.146^{*} (0.077)	0.059^{*} (0.031)	-0.054 (0.054)	-0.062^{*} (0.036)
$D.\ln p$	0.327^{*} (0.172)	-0.076 (0.061)	0.364^{**} (0.171)	0.075 (0.124)	0.352^{*} (0.192)	0.456^{***} (0.095)	0.345^{**} (0.131)	0.163 (0.101)	0.704^{***} (0.098)
$D.\ln prod$	0.029 (0.086)	0.149 (0.215)	0.185 (0.146)	0.539^{**} (0.264)	0.152 (0.175)	0.189 (0.138)	0.582^{**} (0.187)	0.502^{**} (0.156)	0.935^{**} (0.281)
$D.empif$	-0.608^{***} (0.174)	-0.468^{**} (0.157)	-0.391^{**} (0.155)	-0.034 (0.217)	-0.223^{*} (0.126)	-0.431^{**} (0.157)	-0.326^{*} (0.178)	-0.231 (0.153)	-0.219 (0.215)

***denotes significance at the 1% level, ** at the 5% level and * at the 10% level.

'D' denotes the first difference. $\ln nw$: log nominal wage; $\ln prod$: log labour productivity, $\ln p$: log output price; $empif$: 2000 indexed formal and informal employment; SR: short run; ec: error correction term. 1: Agriculture; 2: Mining; 3:Manufacturing; 4: Electricity; 5: Construction; 6: Trade; 7: Transport; 8:Finance; 9:Community services

For the first six sectors, the coefficient on the error correction term is right signed and significant. For the last three on the other hand, the coefficient is significant but wrong signed (transport), insignificant but right signed (finance) and significant and right signed but very small (community, social and personal services). The mining sector stands out with an error correction term coefficient close to the European market. The coefficient on employment keeps a negative sign and is significant throughout except for electricity, construction and community sectors. Given the weak responses of mostly labour productivity and output price throughout, we conclude overall, nominal wages is relatively insensitive to macroeconomic conditions.

5 Conclusion

In this paper we estimate a New Keynesian wage Phillips curve for the South African labour market. We first begin by estimating a model with staggered nominal wage following Erceg, Henderson and Levin (2000) using aggregate quarterly data from 1970Q1 to 2013Q4. Overall the results are in line with economic theory but the difference between accounting for the whole sample and focusing on post apartheid era alone appears significant. In fact, wage inflation and employment have a weak relationship, which becomes even weaker with the most recent sample. Further, nominal wage inflation have a strong and robust relationship which again becomes quantitatively weaker in the second sample (post apartheid era). These results are confirmed when we use unit labour cost as a measure of wage inflation.

Secondly, we turn to investigate, at a sectoral, the responsiveness of nominal wage to output price, productivity and employment, given the reservation wage. Our findings confirm prior expectation of the presence of an error correction term in the wage equation for the South African market; with a significant right signed coefficient of 0.113. Labour productivity has a direct effect on nominal wage and the reservation wage which is however weaker compared to European countries. The major drawback about this second part of the paper is the fact that assumptions on the reservation wage are rather too simple. A better understanding of the determinants of reservation wages for South Africa would therefore be ideal.

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