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Abstract

This paper estimates a New Keynesian Wage Phillips Curve for South Africa to investigate the responsiveness of nominal wages to labour market conditions. The estimation is based on a model with staggered nominal wages setting, where all variations in hired labour input is taking place at the extensive margin. First, we estimate the model using aggregate data from 1971 to 2013. Aggregate estimation results show that private sector nominal wages are not very responsive to employment conditions, while they also reveal a certain sensitivity to inflation and quite a good correlation with inflation expectations. On the other hand, the relationship between nominal wage inflation and price inflation is quite strong and robust for the whole sample. However, it becomes quantitatively weak for the inflation targeting period. In that period, trade unions inflation expectations are instead strongly correlated with nominal wage inflation.

In the second part of the paper, we assess the response of nominal wages to employment, labour productivity and output prices, given 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 price inflation, and that employment conditions had little effect 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 term in the wage equation for South Africa.

The overall picture that comes out from the analysis is that of a wage formation mechanism that is very insensitive to overall macroeconomic conditions.

JEL Codes : E2, E24, E26, E31, E12

Keywords: Wage rigidities, unemployment, labour market, Phillips Curve, New Keynesian.

1. Introduction

The negative relation between the rate of change 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 Non-Accelerating Inflation Rate of Unemployment (NAIRU) setting, relatively recent New-Keynesian literature (for example Gordon 1997, Staiger et al, 1997, Erceg et al, 2000, Gali, 2010, Blanchard and Gali, 2010) 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 is 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. However, if wages do not respond strongly to demand conditions, the potential sacrifice ratio of a contractionary monetary policy can be very significant.

Given these premises, this paper, for the first part, revisits the original findings of Phillips (1958) for the South African economy following the staggered nominal wage setting model introduced by Erceg et al (2000). The staggered nominal wage follows Calvo (1983) formalism to derive what Gali (2011) refers to as the New Keynesian Wage Phillips Curve. The second part of this paper investigates wage rigidities at a sectoral level using data from nine industries, and by also accounting for labour productivity growth and the reservation wage. The overall findings suggest that wages in the economy do not respond strongly to demand conditions, therefore indicating large wage rigidities, low elasticity of substitution and large wage mark-ups. We also find the presence of an error correction term in the South African wage equation, which is an indication that factors including considerable bargaining power unions, rigorous market regulations and a sizeable informal sector have an important impact on wage dynamics.

Gali (2011) reveals the absence of a stable negative relation between inflation and the unemployment rate with a simple observation of US data between 1964Q1 and 2009Q3. Additionally, Ball 1994, Eliasson, 2001, Mankiw, 2001 and Olafsson, 2006 reached the same conclusion especially in the 1970s when both variables increased simultaneously due to the oil price shock. The Phillips curve is however empirically proven in the post 1984 era. Gali (2011) confirms this by estimating a New Keynesian Wage Phillips Curve for the US economy. The South African labour market on the other hand presents features that are unusual by international standards. High and persistent unemployment rates do not prevent the real cost of labour from rising (Fedderke, 2012). This is evidence of strong rigidities that originate from both demand and supply sides of labour.

On the supply side, market segmentation, high reservation wages and the mismatch of skills mainly contribute to the failure of markets to clear. Kingdon and Knight (2004, 2006a, b) argue that the labour market in South Africa is segmented between formal and informal sectors with wages sticky in the former. Moll (1993) and Hofmeyr (2000) identify a segmentation between unionised and non-unionised labour market where wage rigidities are present in the former given the level of bargaining power of unions. Casale and Posel (2002, 2003) and Heintz and Posel (2008) structure the labour market between unionised formal, non-unionised formal and informal segments. Bertrand et al (2003), Dinkelman (2004) and Klasen and Woolard (2005) argue that the reservation wage in South Africa is high which significantly impedes labour market participation. This is further emphasised by the issue of skills mismatched. The education system has failed to provide the labour market with enough skilled workers which undermines the process of firms moving toward greater skills intensity in terms of their employment structure (Bhorat and Hodge, 1999, Banerjee et al 2008, and Rodrik, 2008). An important implication for this is that because the participants in the labour market are unable to send the right signals, labour is often mispriced (Fedderke, 2012). This combined with a low productivity shows that the cost of labour in South Africa is too high (Schussler, 2012, Nattrass and Seekings, 2013), which is the main issue of labour rigidities emanating from the demand side.

The Phillips curve has been consistently investigated in the South African literature as presented in Burger and Markinkov (2006). However, most of these studies focus on the relationship between inflation and the output gap - or in some cases, the deviation of unemployment from its natural rate. This paper revisits the original relationship between (un)employment and wage inflation, given strong labour market rigidities combined with the weak correlation between labour productivity and wage growth rates.

We structure the rest of the article as follows. Section 2 explores the historical development of the Phillips Curve literature in South Africa while section 3 derives the model following Gali (2011). Section 4 gives a glance at the data first and then comments on the empirical results. Section 5 is a sectoral analysis of the responsiveness of nominal wage to output price, labour productivity and employment given the reservation wage. Section 6 concludes.

2. The Phillips Curve in the South African Literature

This section presents an overview of historical developments regarding the Phillips Curve in South Africa. As reported by du Plessis and Burger (2006), evidence of early contributions stretches all the way back to the 1970s and includes works of Hume (1971), Strydom and Steenkamp (1976), and Strebel (1976). The common thread running through these studies is that they all closely followed the framework of Phillips (1958) in investigating the trade-off between nominal wages and unemployment. As the authors highlight, the main drawback about the application of this framework to South Africa was the inaccuracy of the measure of unemployment, which promptly led the authors to move away from unemployment to focus instead on the output gap. In doing so, Truu (1975) and Strydom and Steenkamp (1976) find a significant trade-off between output gap and inflation but only when the sample is restricted to the 1960s.

This consequently raised the question of the presence of the Phillips Curve in South Africa. More importantly, if this presence is then justified, the form that it takes was another relevant interrogation. One thing certain about the South African literature regarding the Phillips Curve is, mainly, how to reconcile theory and empirical realizations. Du Plessis and Burger (2006) emphasize that this ambiguity has divided researchers on the topic into two factions. A first group of authors (Burger and Markinkov 2006; Nell 2000; Strebel 1976) focused on nonlinear specifications in an attempt to at least replicate and identify in the business cycle periods when the trade-off between inflation and output gap associated with the Phillips Curve might have held. On the other hand, a second group adopted a then unorthodox approach by abandoning the hope of including a demand effect in the inflation equation for South Africa, either explicitly (Pretorius and Small 1994) or rather implicitly (Fedderke and Schaling 2005).

Although the original Phillips Curve estimated in 1958 captures the relationship between wage inflation and unemployment, subsequent studies have directed the focus more toward a relationship between price inflation and unemployment or between price inflation and output gap, as commonly found in the literature. The way to estimate the equation therefore merely involves traditionally regressing the change in the level of prices on a measure of output gap for a first group of researchers or regressing the change in the price level on the deviation of unemployment from its natural rate for a second group. Studies from both research factions can be found in the South African literature. For instance, Hodge (2002) belongs to the latter, whereas works similar to the one by Nell (2000) fall into the former category of researchers. Both studies found puzzling results using South African data. Hodge (2002) only finds evidence of a relationship between first differences of inflation and growth, whereas Nell (2000) could only reconcile theory and data during periods of accelerating inflation when the economy overheats. This has therefore led to criticisms of the traditional way of estimating the equation, and early works such as Gordon (1990) already argued the traditional approach generates biased results.

Gordon (1997) therefore introduced a triangular model that has the novelty of controlling for inertia effects, output levels, and the rate of change in output effects. He finds relevant results for various European countries, the United States, and Japan. After exploring how Gordon (1997) departs from the then mainstream literature, Burger and Markinkov (2006) apply the model to South Africa. Furthermore, building on the findings of Nell (2000), the authors split their measure of output gap into two to accommodate for periods when the economy overheats and for times when economic activities are relatively weak. They find that a triangular approach for the Phillips Curve applies in South Africa only to a certain extent. They find evidence of inertia effects, but output level and output rate of change effects are clearly absent. Interestingly, when accounting for the unit labour cost, Burger and Markinkov (2006) find a statistically significant parameter in all of their regressions. Therefore, the authors suggest that further research regarding labour market effects on South African inflation should be investigated. This finding, in itself, provides a motivation for this paper.

We follow closely the framework of Gali (2011) and use a model that accounts for price inflation, wage inflation, and (un)employment. This approach of estimating the Phillips Curve, by taking into account wage rigidities, is particularly interesting given that the South African literature in this subject focuses mainly on price inflation dynamics alone. Very few studies

(Gallaway et al. 1970; Levin and Horn 1987; Strydom and Steenkamp 1976) have focused on the wage inflation in the past. The framework introduced by Gali (2011) is briefly laid out in the next section.

3. The Model

3.1 The Basic Model

This model assumes indivisible labour with all the variations in hired input taking place in the form of variations in employment. There is a large representative household with 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 labor in which a given household member is specialized. The second dimension, on the other hand (indexed by $j \in [0,1]$), defines his disutility from work. This disutility is given by $\chi \vartheta^{\varphi}$ if he is employed, zero otherwise. $\varphi \geq 0$ defines the elasticity of the marginal disutility of work, and $\chi_t > 0$ is an exogenous preference shifter, which we also refer to as a labor supply shock given the impact it has on labor supply.

Following Merz (1995), Gali (2011) defines a utility that is logarithmic in consumption. Further, 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 the following:

$$U(C_t\{N_t(i)\}, \chi_t) \equiv logC_t - \chi_t \int_0^1 \int_0^{N_t(i)} j^{\varphi} djdi$$

$$U(C_t\{N_t(i)\}, \chi_t) \equiv logC_t - \chi_t \int_0^1 \frac{N_t(i)^{1+\varphi}}{1+\varphi} di,$$

where C_t denotes household consumption, and $N_t(i)$ is the fraction of members specialized on type i labour who are employed in period t. The household seeks to maximize:

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

subject to the following budget constraint:

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

where β is the discount rate, P_t is 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 lump sum component of income, which may include dividends from ownership of firms.

Wage rigidities are introduced in the model assuming the formalism of Calvo (1983). Therefore, workers supplying a labour service of a specific type get to reset their nominal wage with probability $1 - \theta_w$ each period. This probability is independent across labor types. In addition,

it is not affected by the time that has gone by since the wage was last reset. Another fraction of workers, θ_w, keep their wage unchanged in any given period. θ_w is therefore defined 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 their specialized 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 reoptimize their wage in period t choosing a wage W_t^* that maximizes the household utility as opposed to their own individual utility, subject to a sequence of isoelastic demand schedules for their labor type and the usual sequence of household flow of budget constraint. The following first order condition is therefore derived and written as:

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

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, $M^w \equiv \epsilon_w/(\epsilon_w - 1)$ is the desired or flexible wage markup, with ϵ_w denoting the constant wage elasticity of demand for services of each labor type.

After log-linearizing the above optimality condition around a zero inflation steady state and using lowercase letters to indicate the log of the corresponding variable, the following approximate wage setting rule is obtained:

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

where $\mu^w \equiv logM^w$.

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.

Assuming $mrs_t \equiv c_t + \varphi n_t + \xi_t$ denotes the economy's average log marginal rate of substitution, where $\xi_t \equiv log\chi_t$,

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

Log-linearizing the expression for aggregate wage index around a zero inflation steady state gives:

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

By combining (1) and (4), the baseline wage inflation equation is obtained:

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

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

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,

$$\pi_t^w = -\boldsymbol{\lambda}_w \sum_{k=0}^{\infty} \beta^k E_t\{(\mu_{t+k}^w - \mu^w)\} \qquad (6)$$

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 vice versa.

In the literature, the estimated version of the foregoing generally allows for automatic indexation to price inflation of the wages that are not reoptimized in any period. However, following Gali (2011), we assume the indexation rule given by

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

for k = 1,2,3 ..., where $w_{t+k|t}$ denotes the period t + k log wage for workers who last reoptimized their wage in period $t\,(with\, w_{t|t} \equiv w_t^*)$, $\bar{\pi}^p$ 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:

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

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

3.2 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 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:

$$w_t - p_t = c_t + \varphi l_t + \xi_t \qquad (9)$$

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.

Gali (2011) defines the unemployment rate u_t as follows:

$$u_t = l_t - n_t \qquad (10)$$

By combining (9) and (10) with the expression for the average wage markup given by $\mu_t^w \equiv (w_t - p_t) - (c_t + \varphi n_t + \xi_t)$, the following linear relationship between the wage markup and the unemployment rate can be written as:

$$\mu_t^w = \varphi \mu_t \qquad (11)$$

The natural rate of unemployment, u_t^n, is defined 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:

$$u^n = \frac{\mu^w}{\varphi} \qquad (12)$$

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

Combining (5), (11), and (12) gives the following New Keynesian Phillips Curve:

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

By combining equations (8) and (11), the following augmented New Keynesian Wage Phillips Curve implied by Gali (2011) is obtained:

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

It is important to note that even though equation (13) shows a relationship between wage inflation and the unemployment rate, it differs from the original Phillips Curve first uncovered by Phillips (1958). 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 wages approach full flexibility, the curve becomes vertical. Secondly, equation (13) defines wage inflation as a forward looking variable that is in contrast to 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:

$$\hat{u}_t = \phi_1 \hat{u}_{t-1} + \phi_2 \hat{u}_{t-2} + \varepsilon_t \qquad (15)$$

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

$$\pi_t^w = \alpha + \gamma \bar{\pi}_{t-1}^p + \psi_0 \hat{u}_t + \psi_1 \hat{u}_{t-1} \qquad (16)$$

where

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

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

Equation (16) is therefore estimated in the next section.

4. Empirical Results

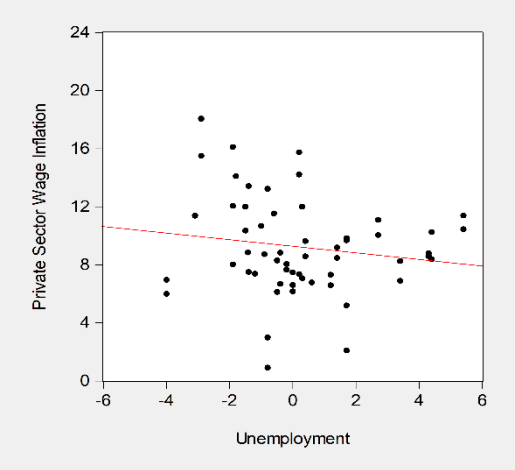
4.1 Data

Labour market data in South Africa is notoriously unreliable and subject to extensive change in definition. 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 Consumer Price Index as a measure of price inflation and two alternative sources of wage data, namely, the remuneration in the private sector, and unit labour costs in the manufacturing sector. Wage inflation is measured as the centred four-quarter difference of the log of nominal wage expressed in percentage terms. The same applies for price inflation. The cyclical unemployment, measured 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 revision, 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 for 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, whereas the unemployment series is demeaned of the average value of 23% unemployment rate, which we implicitly 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 commenting on the regression analysis, it is worth having a quick look at the data to be used in estimating specification (16). The basic hypothesis common with the old Phillips Curve specification is that there is a negative relationship between wage inflation and unemployment.

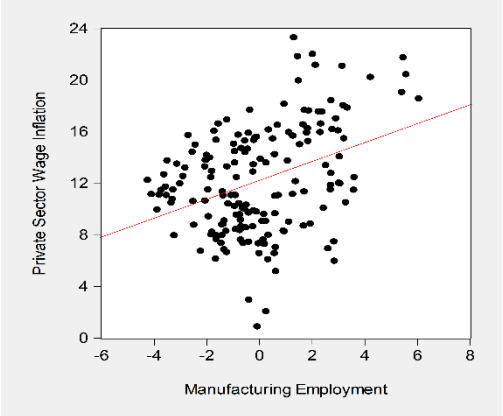
In Figure 1, we display this relationship for the period 2000–14 in two scatterplots of wage inflation and unemployment to check if such a relationship applies in the case of South Africa.

Figure 1: Private sector wage inflation and unemployment



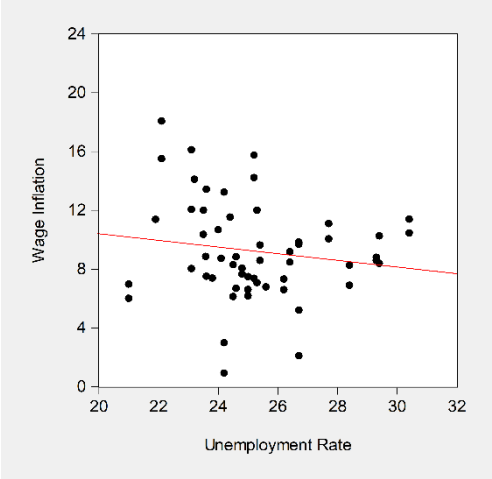
The relationship appears immediately to be quite weak. This could be because of the specific definition of unemployment used in South Africa. As argued by Banerjee (2008), a lot of the changes in the employment rate observed are accounted for by the change in labor participation rate. Thus, a positive relationship between wage inflation and employment rate could be more revealing. Figure 2 shows the relationship between wage inflation and manufacturing employment between 1971 and 2014.

Figure 2: Private sector wage inflation and manufacturing employment



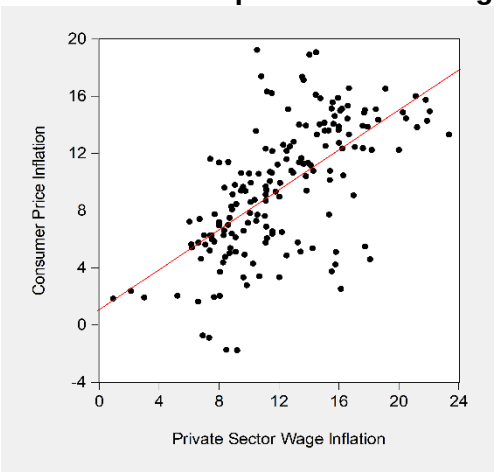
The positive relationship between wage inflation and employment seems much more promising, as is the relationship between wage inflation and total private employment. Less promising is the same relationship once viewed from the inflation targeting period 2000–14, in Figure 3.

Figure 3: Wage inflation and unemployment 2000–13



The final relationship in equation (16) is the one between wage inflation and price inflation. Historically, the relationship appears very strong, as shown here (Figure 4).

Figure 4: CPI inflation and private sector wage inflation

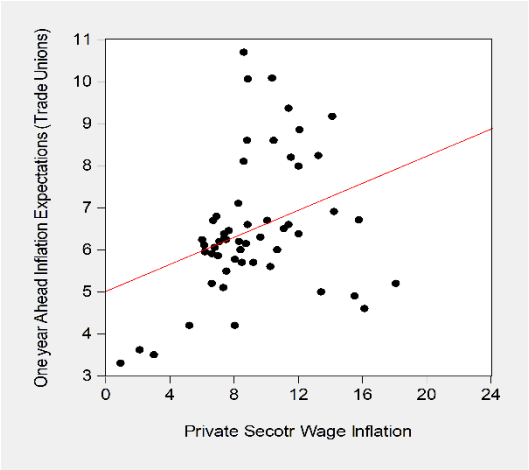


The relationship appears to weaken during the inflation targeting period, as is to be expected if monetary policy tries to insulate the overall price level from a change in the relative price of labour (Figure 5).

Figure 5: CPI inflation and private sector wage inflation 2000–13

On the other hand, there seems to be a strong correlation between wage inflation and inflation expectations of trade unions, as recorded by the BER, a fact that gives some indication that controlling inflation expectations might still be the most direct way to control wage dynamics (Figure 6).

Figure 6: One year ahead, trade unions' inflation expectations and private sector wage inflation



4.2 Estimation Results

In the following tables we report OLS estimates of several specifications of the New Keynesian Wage Phillips Curve, each specification being a restricted version of equation (16). The standard errors are reported in brackets. In Table 1, columns (1) and (2) report the traditional Phillips Curve relationship between employment and wage inflation, for the whole sample in column (1) and for the post apartheid subsample in column (2). In columns (3) and (4), we report the results of introducing past inflation in the specification to capture inflation expectations, and, finally, in columns (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 is also quantitatively 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*** (012)

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

The results are largely confirmed if a different measure of the change in labour cost is considered. In Table 2 we use the nominal unit labour cost inflation as a measure of wage, which has the advantage of separating the growth 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 though 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	0.19*** (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*** (012)

***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)	(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*** (012)

***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 perhaps attributable 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)	(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*** (012)

***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 estimation results imply a significant wage rigidity relative to either employment or unemployment conditions, with a certain sensitivity to inflation and inflation expectations. The next step is to conduct a sectoral analysis to investigate the responsiveness of wages to output prices given the level of labour productivity and the reservation wage.

5. A Sectoral Analysis of Wage Responsiveness to Employment Conditions

Economic theory suggests that there is a positive link between wage and labour productivity. When output per worker rises, this creates an incentive for firms to increase their demand for workers, which ultimately results in an increase in workers' compensation. This theory is backed up by empirical evidence in countries that include Israel (Lavi and Sussman 2001), Australia (Kumar et al. 2009), the United States (Strauss and Wohar 2004), as well as South Africa (Fallon 1992; Fallon and da Silva 1994; Klein 2012; Wakeford 2004). Most of these studies, however, find a weak link between wage and labour productivity as far as the South African labour market is concerned. The absence of a strong relationship between these two variables has direct implications for firms' profitability, which in turn may have acute repercussions in terms of job creation and, finally, in terms of unemployment. This has often been highlighted in the literature as an explanation for the severe job shedding the economy witnessed in the aftermath of the 2008 financial crisis.

Furthermore, it is important to note that the weak link between wage and labour productivity can be explained by the presence of noises of macroeconomic and/or institutional nature. Klein (2012), for instance, argues that the presence of these factors may create a wedge between the two variables, which may explain why gains in labour productivity are not fully translated into wage increases. The main factors highlighted in his study include price and wage rigidities, labour adjustment costs, and other structural factors (market regulations, entry restrictions, etc.). Bentolila and Sain-Paul (2003) emphasize the bargaining power of workers in wage settlements as an important player in weakening the relationship between labour productivity and wage. This article focuses on the role played by reservation wages.

Very few studies in the South African literature focus on the impact of reservation wages on the functioning of the labour market. Rankin and Roberts (2010) highlight two studies regarding the subject. These studies (Kingdon and Knight 2000; Nattrass and Walker 2005), along with the recent work of Levinsohn and Pugatch (2010), focus on the role of reservation wages in explaining youth unemployment. Our study in this section diverges from the available literature in the sense that the focal point here is to investigate the link between reservation wages and labour productivity in explaining the existence of wage rigidities at a sectoral level.

5.1 A Simplified Model

We begin the layout of the model following Blanchard and Katz (1999) with a textbook Phillips Curve equation of the following form:

$$(w_t - w_{t-1}) = a_w + (p_{t-1} - p_{t-2}) - \beta u_t + \epsilon_{t,} \qquad (17)$$

where p_t and w_t are, respectively, logarithms of the price level and the nominal wage, u_t is the unemployment rate, aw is a constant, and is ϵ_t 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 also write as $(p_t^e - p_{t-1})$

After reorganizing equation (17), it takes the following familiar form:

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

The empirical wage equation implies that the expected log real wage depends on the lagged log 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 (Blanchard and Katz 1999; Blanchower and Oswald 1994) suggests 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 and Pissarides 1994) deliver a representation of a wage relation of the following form:

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

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 foregoing relationship simply means that the expected real wage depends on both the reservation wage, which is basically the wage if unemployed, and on the level of productivity.

A quick look at the wage Phillips Curve (18) and the theoretical wage relation nested in (19) reveals two striking differences. First, 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. Blanchard and Katz (1999) provide an extensive discussion of the determinants of the reservation wage, which help them establish the conditions under which the wage Phillips Curve and the theoretical wage relation can be reconciled.

Given that the reservation wage is, by definition, 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 suggests that the reservation wage will move with lagged wages. It seems logical, then, to assume that worker's aspirations in job search and wage bargaining would very likely be 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 or 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 and home production are closely related to those in the formal sector. Finally, the reservation wage also depends on nonlabour income. Thus, productivity increases lead to equal proportional increases in labour and nonlabour 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:

$$b_t = a + \lambda(w_{t-1} - p_{t-1}) + (1 - \lambda)y_{t,} \qquad (20)$$

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 (19), we obtain:

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

From the foregoing equation, the theoretical wage relation in (21) is seen to be consistent with the Phillips Curve representation given by (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) There is no direct effect of productivity on wages given the reservation wage $\mu = 1$, and (b) there is no direct effect of productivity on the reservation wage $\lambda = 1$. The strong performance of a standard wage Phillips Curve specification on U.S. data suggests that $\lambda\mu = 1$ may be a reasonable approximation for the U.S. labour market, as suggested by Blanchard and Katz (1999). On the other hand, the authors argue that the same findings do not apply to the European labour market. The striking difference between the empirical wage and unemployment relation in the U. S. and Europe is a well-known fact. In the current case, however, the presence of an error correction term in the European and its absence in the U.S. 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 the South African error correction term relative to the European labour market?

Before discussing the differences between the three economies, let us begin by rewriting (21) into:

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

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 U.S. labour market is close to zero, with point estimates that are wrong signed, small, and insignificant. On the other hand, in most European 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 (1999) discuss what could possibly explain the difference between European and U.S. labour markets.

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

Given these arguments, prior expectations would suggest that the South African labour market may be similar to the European one given the resemblance in terms of high bargaining power of workers, rigorous market regulations, and a sizable informal sector.

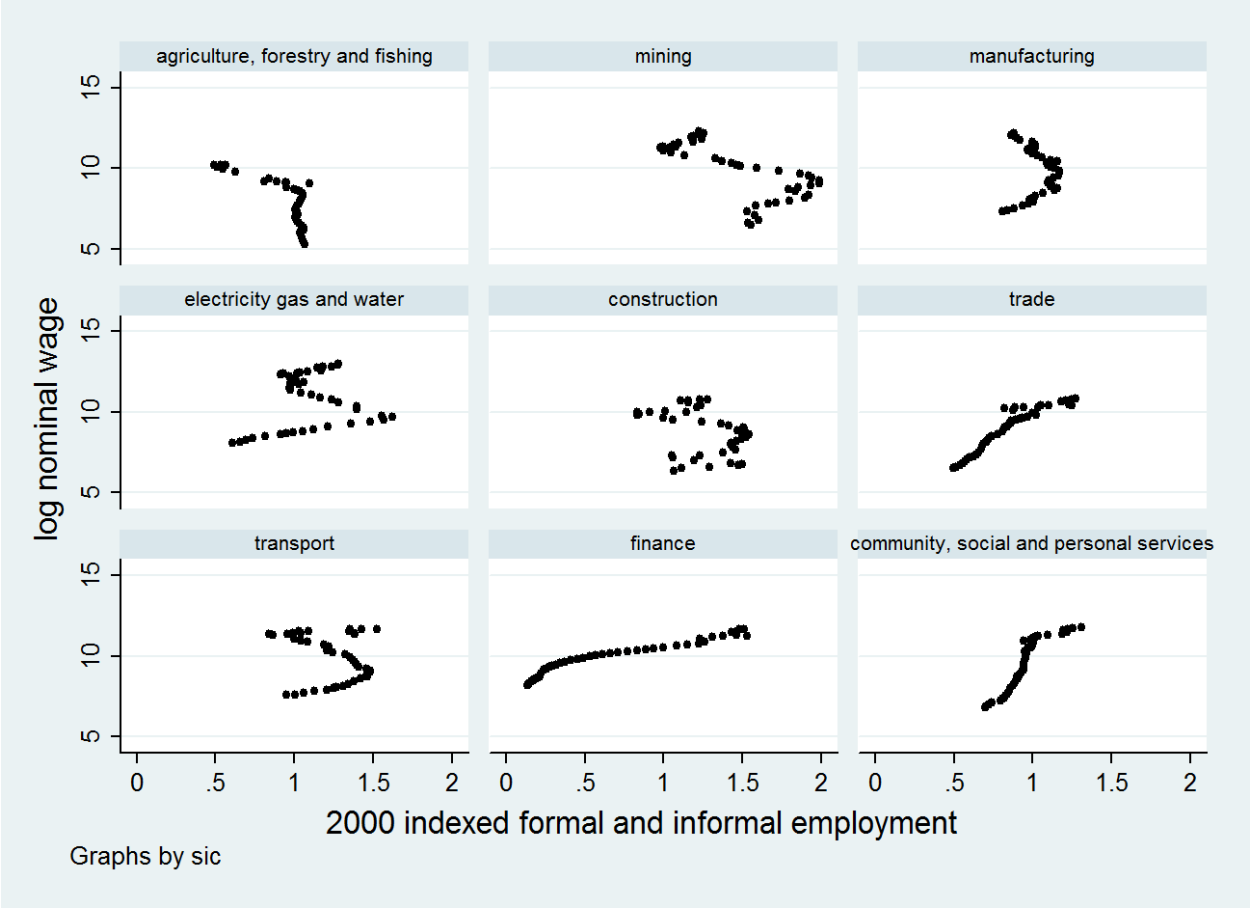
5.2 Empirical Study

5.2.1 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 1970–2013. Nominal wage is captured by the nominal remuneration per employee by sector. We use output price by sector as a measure of variable price and rely on 2000 indexed employment data. We take into account both formal and informal measures of employment per sectors. Finally, labour productivity is captured by an index of labour productivity per sector.

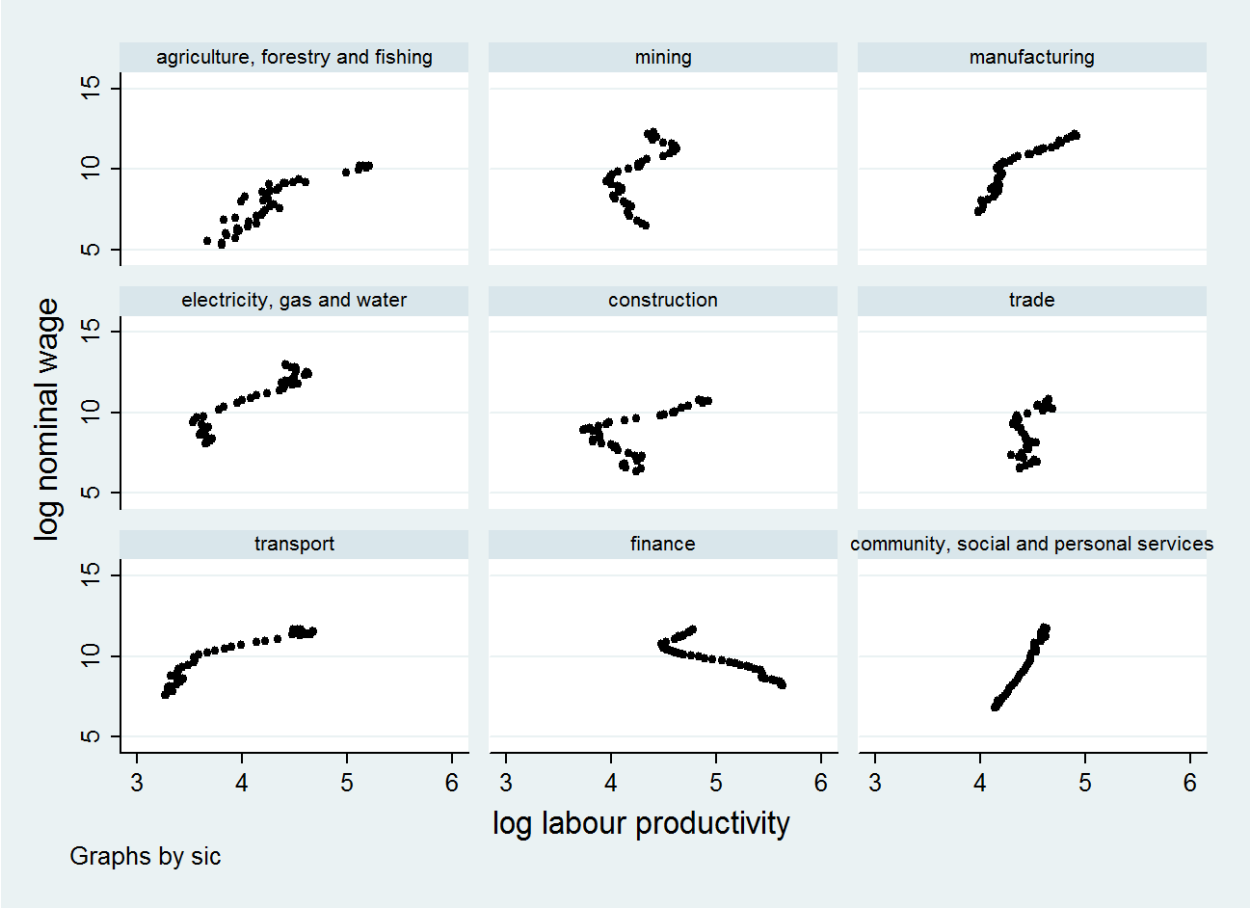
Before discussing the empirical results, we begin with a quick look at the data (Figure 7).

Figure 7: Nominal wage and employment



The correlation between nominal wage and employment appears positive throughout, although the relationship is weak and relatively inconclusive in the case of the agriculture, forestry, and fishing sectors. We observe a strong positive correlation for the trade and community, social, and personal services sectors. These two sectors are predominantly composed of public sector firms (Figure 8).

Figure 8: Nominal wage and productivity



The figure above reveals at first glance that the correlation between wages and labour productivity is relatively weak and positive across sectors. This is perhaps explained by the rise in earning equalities since the abolishment of the apartheid regime and, to some extent, by measurement issues. Also, we cannot rule out an increase in output prices relative to the price of other goods and services workers purchase in the markets. A wage increase forces firms to increase the price of products they sell in the market in an apparent attempt to pass on that increase in the cost of production through to the workers. The sector that stood out, however, is the community, social, and personal services sector, where we observe a remarkably strong positive correlation between wages and labour productivity.

5.2.2 Empirical Results

We estimate the model using pool mean group estimation techniques, which is suitable for nonstationary heterogeneous panels. We investigate the existence of a long-run relationship between nominal wages, output price, and labour productivity and the presence of an error correction term in the South African wage equation. Variables in the short run include nominal wage, output price, labour productivity, and employment in both formal and informal sectors. Furthermore, it is important to highlight that in the equation we estimate, the coefficient on

unemployment is negative, suggesting an inverse relationship between real wage and unemployment. Because the measure for unemployment is unreliable, we use employment data instead, as mentioned in the data description section. This explains the negative sign on the coefficient estimate for employment in the results. This, however, should be interpreted as a positive relationship because the sign on β in equation (22) is already negative. The overall results are reported in the following table.

Table 5: Pool Mean Group Estimates

	(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*** (012)

***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 expectation of the existence of an error correction term in the wage equation for South Africa is confirmed. The coefficient is right signed and significant but is lower than the findings of Blanchard and Katz (1999), of 0.25, for the European market. This finding therefore has some implications in terms of certain features of the South African labour market, which suggests there are some unobservable variables that may affect wages. Some of these features are similar to those found in the European labour market. In particular, the sizable bargaining power of trade unions, rigorous market regulations, and the considerable size of the informal sector all play a significant role in explaining the existence of the error correction term in the South African wage equation.

In the long run, we find the coefficients on price and labour productivity to be very close to 1, which is in line with prior expectations. In the short run, on the other hand, these coefficients are quantitatively smaller and remain significant. The coefficient estimates of price, labour productivity, and employment are all right signed and significant. However, the values we find are also all quantitatively small. This suggests that the weak response of wages to market conditions can therefore also be confirmed at the sectoral level. Intuitively, if increases in wages are not correlated with the rise in labour productivity growth, then a negative shock will inevitably lead to considerable job shedding and a reduction in employment, ultimately translating into a rise in unemployment. Additionally, increases in wages often result in a rise in inflationary pressures, which the monetary authority can only offset by inducing large contractions in demand.

Table 6: Pool Mean Group Estimates Per Sectors

d.lnnw	1	2	3	4	5	6	7	8	9
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.lnp	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.lnprod	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.emp	−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 labor 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, social, and personal services.

For the first six sectors, the coefficient on the error correction term is right signed and significant. On the other hand, in the last three columns, we report coefficients that are 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 the right sign and is significant throughout except for electricity, construction, and community, social, and personal services sectors. It is important to note that this coefficient estimate is relatively close to the value found in the previous section, except for the agriculture sector, where wages and employment display a rather strong correlation.

Regarding the response of wages to labour productivity, we find that to be insignificant for sectors including agriculture, mining, manufacturing, construction, and trade. The coefficient estimates for labour productivity for sectors we find statistically significant are mostly in line with the literature. For instance, Klein (2012) reports an average value of 0.45 for non-agricultural sectors. This is an indication that labour productivity does not fully translate into an increase in wages. Therefore, as discussed earlier, there are other factors involved that may account for this weak response of wages to increase in labour productivity. The community, social, and personal services sector, however, is a very appealing exception, which confirms prior expectations after the first glance at the data. We argue that this sector is predominantly skilled workers intensive, which may explain why there appears to be a strong link between wages and labour productivity when we take into account the reservation wage.

6. Conclusion

This article estimates a New Keynesian Wage Phillips Curve for the South African labour market. First, we estimated a model with staggered nominal wage, following Erceg et al. (2000), using aggregate quarterly data from 1970Q1 to 2013Q4. Overall, the results were found to be in line with economic theory, but the difference between accounting for the whole sample and focusing on the post apartheid era alone appears significant. Typically, we find that wage inflation and employment have a weak relationship, which becomes even weaker with the most recent sample. Further, nominal wage inflation and price 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 investigated, at a sectoral level, the responsiveness of nominal wage to output price, labour productivity, and employment, given the reservation wage. Our findings confirm prior expectations of the presence of an error correction term in the wage equation for the South African labour market, with a significant and right signed coefficient of 0.113. This coefficient is smaller relative to the finding of the European labour market. Nevertheless, the existence of the error correction term in the wage equation confirms that certain features of the labour market contribute to the rigidities of wages. These features include a considerable bargaining power of trade unions, strict hiring and firing regulations, and a sizable informal sector. It is important to highlight that despite these rather interesting findings, a better understanding of the determinants of reservation wages for South Africa may be required. Most of the studies in the available literature focus mainly on the impact of the reservation wage on explaining youth unemployment, rather than assessing its contribution to the weak response of wages to labour market conditions.

Overall, for the first section, the results reveal a decent evaluation of the South African labour market at an aggregate level, despite the crucial lack of data we face in this investigation. This forces us, for instance, to use employment data instead of the ideal choice that would have been unemployment. Nonetheless, we have drawn conclusions that are mostly in line with available South African literature, i.e., wages are not very responsive to labour market conditions, suggesting that there exist other factors that prevent a better response. This raises questions in terms of the conduct of monetary policy, given the current environment. Furthermore, in the second section, the curious case of the community, social, and personal services (which is dominated by public sector firms) sparked interrogations given the strong responses of labour productivity and prices to wages. A priori, we suspect that such results can be explained by the fact that the sector is mainly skilled workers intensive. Given the scarcity of skilled workers in the South African labour market, this may have implications for private sector firms' decisions.

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