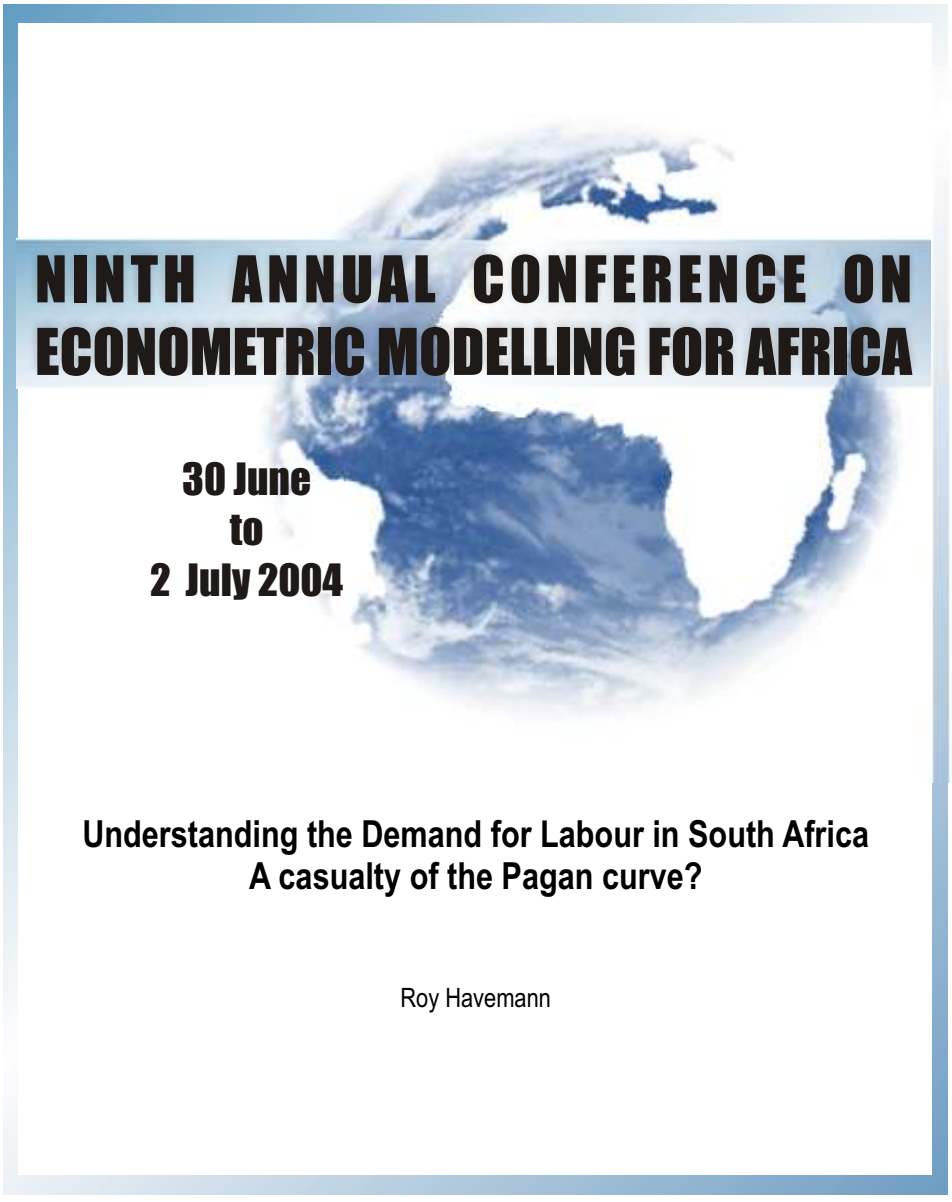

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Understanding the Demand for Labour in South Africa
A casualty of the Pagan curve?

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A casualty of the Pagan curve?

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Abstract

There is a reasonably healthy time-series literature on the demand for labour in South Africa, yet not one of the models appears to capture all the diverse factors influencing the demand for labour. The literature has also been criticised (sometimes unfairly) because it does not account for 'feedback' effects – that changes in wage rates have both direct consequences on the demand for labour (through relative-price effects) and indirect consequences (by having demand-side effects).

The second criticism is that 'structuralist' labour market theories are not incorporated. This paper proposes that this is due to the 'Pagan-curve effect', i.e. that in any model there is a trade-off between theoretical and empirical coherence. It is impossible to both:

- capture all the theoretical determinants of the demand for labour in a quantifiable way (a "quantification problem"); and
- explain the identified empirical relationships through the lens of theory (a "qualification problem").

The paper reviews a selection of the literature, which ranges from theory-only models to rigorous empirical work. Then a small structural model of the demand for labour is estimated, drawing on both the theoretical and empirical literature.

The conclusion is the Pagan-curve provides a useful framework within which to consider the process of modelling and understanding policy questions.

[1] I would like to thank Haroon Bhorat, Stan du Plessis, Kevin Fletcher and Servaas van der Berg for comments on earlier versions of this paper. The remaining errors are my own.

Introduction

There is a reasonably healthy literature on the demand for labour in South Africa. The literature has, however, been subject to two important criticisms. Most important of these is the presence of 'feedback' effects, i.e. that changes in wage rates have both direct consequences on the demand for labour (through relative price effects) and indirect consequences (by, for example, having demand-side effects). The second critique is that the literature is too 'neoclassical' in its approach and ignores the large body of theoretical work on structural rigidities.

This paper hopes to contribute to the literature by presenting a framework within which these two criticisms can be addressed.

Feedback effects are incorporated using a small, six-equation structural model. Controlling for feedback effects has the expected result of making the wage elasticity of employment less negative. Without feedback effects, the wage elasticity is estimated to be approximately -0.7, whilst with feedback effects it is closer to -0.6. An increase in real wages creates a short-run growth stimulus but this comes with inflationary effects and a corresponding tightening of monetary policy. Overall, employment falls and the economy is left not much better off than before. The employed receive increased income mainly at the expense of the unemployed, whilst employers' profits are increased, at least in nominal terms.

On a more philosophical note, it is clear that it is difficult to completely reconcile labour market theory and empirics. This is due both to quantification problems (data cannot be found to test theory) and qualification problems (theory cannot be found for observed empirical regularities). This is broadly in line with the thinking behind Adrian Pagan's (2003) stylised curve that proposes that there is an implicit trade-off between theoretical and empirical coherence.

The South African context

Economic events of the 1990s were a significant turning point in the economic history of South Africa. A combination of drought, a world slowdown, political uncertainty and sanctions meant that the early 1990s were characterised by a severe, sustained recession (Wakeford, 2003). The inevitability of a loss of power led the minority government to pursue somewhat imprudent fiscal policy, cynics would suggest to buy sorely-needed popularity from the black majority. The expansionary fiscal stance (a deficit of 7.2 per cent of GDP in 1993), external vulnerability and political uncertainty led to extremely cautious monetary policy from the central bank, which only worsened the situation.

Against this background, significant policy changes occurred. After the extension of the franchise to all in 1994, the new government took a bold new policy direction. An inefficient, highly protected, stagnant economy isolated by sanctions was transformed into an outwardly-oriented, trading nation as policy shifted from depending on inward industrialisation to export-led development (Levy, 1992; Weeks, 1996; Edwards and

Golub, 2000; Makgetla and Von Meelis, 2003). In the short-term this placed severe pressure on domestic firms to become more competitive, both in terms of what they produced and how they produced it, and entailed some short-term pain (Standing, Sender and Weeks, 1996; Roberts, 1998). The longer term results have been though to increase investment, reduce interest rates, inflation and have led to a rise in the underlying trend growth rate (National Treasury, 2004).

Jobs, however, remain scarce. Estimates are that there are approximately 4.6 million South Africans are without work, out of an economically-active population of 14 million. There are a further **xx** discouraged workers, who would seek work if it were more readily available.

The labour market is characterised by a relatively strong union movement, mainly for historical reasons (unions were one of the few ways for disenfranchised South Africans to influence political developments during apartheid). In a post-apartheid South Africa, unions have also worked towards reducing wage inequalities (O'Sullivan and Adler, 1996), increasing artificially low unit labour costs, although with the unintended consequence of a corresponding decline in the demand for labour. Unionised workers have got ahead and are concentrated in the upper income deciles with 61.8 per cent of trade union members in the top two income deciles (Van der Berg, 2003)

A number of structural changes have also impacted on the functioning of the labour market. The first was the substantial political changes of the early 1990s. Although unions retain political influence through the membership of the Congress of South African Trade Unions of the governing alliance, their political power has waned. Union activity is no longer concentrated on achieving political ends, but rather on economic ones. Labour union power has been channelled to some extent by consensus politics, through the creation of fora such as the National Economic Development and Labour Council (NEDLAC). Bargaining councils have led to decreased employer / employee friction, although these councils have been criticised because they centralise wage negotiations, and may not take into account the needs of employers and employees on the periphery (see, for example, IMF, 2003), whilst it is often argued that the labour market legislation increases costs of employment (Black and Rankin, 1998; Barker, 1999; Aron, Muellbauer and Smit, 2003).

Also, there has been a market shift in labour demand patterns from low-skilled workers to higher-skilled workers (Bhorat and Hodge, 1999). This may, to some extent, be a function of a rising real wage or the demands of an economy that is increasingly reliant on productivity growth to sustain itself (see Fedderke, 2000, or Arora and Bhundia, 2003).

Previous estimates of labour demand functions

Against this background, a number of researchers have estimated labour demand functions to try and better understand the functioning of the labour market. This section first discusses the methodology of some of the papers in the literature and then concludes with a summary table of the calculated elasticities.

A pair of World Bank papers, Fallon (1992) and Fallon and Lucas (1998), laid the basis for much of the time-series empirical work on the demand for labour in South Africa. The contribution of these two papers is the way in which they incorporate labour market structural rigidities. Fallon (1992) disaggregates the labour market into three 'skills' groups, and he uses race as a proxy for skill. The second innovation is to use a constant elasticity of substitution function to model the labour market. The second paper, Fallon and Lucas (1998) builds on the first in that it rather uses a pooled cross-industry time-series regression. This increases the size of the data set and allows for the estimation of industry-specific labour market elasticities. In addition, race is used explicitly, rather than merely as a proxy for other variables. In both papers, the modelling of different race groups affords the researchers the opportunity to capture some of the labour market segmentation that occurred as a result of apartheid. Other variables used by Fallon and Lucas (1998) to capture structuralist factors include the unemployment rate, the proportion of unionised workers an 'apartheid index' (which measures the proportion of black South Africans prosecuted), the lagged minimum wage, a time trend, the lagged value of real consumption wages and unanticipated inflation.

Fields, Leibbrandt and Wakeford (2000) were commissioned by the then Department of Finance to estimate key labour market elasticities. They use a standard labour-demand equation, which uses real wages, user cost of capital and the level of output. **xx**. One of the difficulties with labour market time-series data is getting a consistent set of data over any length of time. To get around this problem, Fedderke and Marrioti (2002) use a Pesaran, Shin and Smith unrestricted error-correction ARDL panel. The advantage is that it allows the authors to use a relatively short data set, in this case annual data for the period 1970 to 1997 and still have a large number of observations. Their findings are in line with those of Fields *et al* (2000), in that it is found that there is a negative relationship between real wages and the demand for labour. There is a similar result for cost of capital. Output, on the other hand, has a positive effect on the demand for labour.

A more supply-side approach is used by Du Toit and Koekemoer (2002). They use a well-developed theoretical framework within which to consider a number of issues. These include the presence of a segmented labour market, where the market for skilled and unskilled labour functions differently. The model explicitly accounts for a union-bargaining framework, imperfect competition in goods market and the role of taxes. Unfortunately, the necessary data to empirically estimate a model such as this. Nevertheless, paper significantly contributes to the understanding of the theory underpinning the demand for labour.

The relationship between productivity, real wages and unemployment is the subject of some debate within labour market circles. Wakeford (2003) considers the complex relationships between these variables more carefully. A number of interesting questions are considered including whether or not increased real wages would lead to an increase in productivity. He uses cointegration analysis and concludes that labour productivity increases real wages, but that real wages do not necessarily lead to higher productivity. This casts doubt on the oft-repeated claim that the efficiency wage hypothesis holds in South Africa.

The empirical estimates from the literature are provided in TABLE 1.

TABLE 1: Summary of the literature

Study	**Wage elasticity of employment**	**Output elasticity of employment**	**Productivity elasticity of wages**
Fallon and Lucas (1998)	-0.709		-
Fields *et al* (2000)	-0.53	0.83	0.86
Fedderke and Mariotti (2002)	-0.502 to -0.552	0.857 to 1.002	-
Du Toit and Koekemoer (2003)			
Skilled labour force	-0.198	0.224	-
Unskilled labour force	-0.056	0.344	-
Wakeford (2003)	-	-	0.5

Source: see list of references

Some theory

It may be useful to briefly digress to set out the labour market theory underpinning the empirics to follow. Any labour market discussion must be grounded with the textbook neoclassical model, which proposes that relative prices and aggregate demand determines the demand for labour. Formally, the demand for labour can be derived as follows (adapted from Silberberg in Bosworth *et al* 1996). Assume that the firm minimises costs subject to an output constraint in a two-factor input model, i.e.:

$$c = rK + wL \quad \text{such that} \quad Y_0 = f(X_1, X_2) \qquad (1)$$

This can be rewritten as the following Lagrangian problem, where $\mathcal{L}$ represents the Lagrangian:

$$\text{Min } \mathcal{L} = rK + wL + (Y_0 - \text{f}(L,K)) \qquad (2)$$

To solve, the derivatives of $\mathcal{L}$ with respect to X_1, X_2 and are set to a minimum:

$$\frac{\partial L}{\partial K} = \mathcal{L}_1 = r - f_1 = 0 \qquad (3)$$

$$\mathcal{L}_2 = w - f_2 = 0 \qquad (4)$$

$$\mathcal{L}_3 = Y_0 - \text{f}(K,L) = 0 \qquad (5)$$

Solving equations (3) to (5)

$$K = K(r, w, Y_0) \qquad (6)$$

$$L = L(w, r, Y_0) \qquad (7)$$

$$= (r, w, Y_0) \qquad (8)$$

In this case, can be interpreted as the marginal cost function of the firm. From this very general model, it can be shown that:

$$\frac{\partial K}{\partial r} < 0; \frac{\partial K}{\partial w} > 0; \frac{\partial L}{\partial r} > 0; \frac{\partial L}{\partial w} < 0 \qquad (9)$$

Equation (9) simply formalises the intuitive result. The higher the cost of capital, the less capital is used. The higher the wage rate, however, the more capital will be used. Similarly, the higher the cost of capital, the more labour will be used.

This result can relatively easily be extended to include more than one factor of production (see, for example, Hamermesh 1993: 34). This provides the static result, but a dynamic result can also be considered, where adjustment costs matter (see, for example, Hamermesh 1992: 733).

Labour market theory does not stop there, though. The experience of the Great Depression ushered in a period where neoclassical arguments were largely questioned, and in some cases discarded. Keynes (1936: 6) sets out the problem of *wage stickiness*, where labour markets do not clear because of wage rigidities. Other explanations of

why labour markets do not clear include *wage contracts* (Romer 1996: 463), the need to pay *efficiency wages* to stimulate productivity, particularly in developing countries (Leibenstein 1957; Stiglitz 1976; Katz 1988; Akerlof and Yellen 1986), *insider-outsider* models, where workers with jobs conspire to keep the unemployed out (Lindbeck and Snower 1988, 1990, 2001; Blanchard and Summers 1986) and *search-and-matching* models where frictional unemployment occurs because potential employers and workers take time to find each other (Mortensen 1982; Pissarides 1985; Mortensen and Pissarides 1999).

A new framework

This paper builds on the existing literature in three ways:

1. By estimating the demand for labour within the context of a broader macroeconomic system; and
2. Considering ways in which 'structuralist' theories of the labour market can be incorporated empirically.

The theoretical underpinnings of the idea of the labour market as part of a larger macro-system be traced to Blanchard and Fischer (1996: 518 *et seq*), Layard, Nickell and Jackman (1991: 362 *et seq*) and Agénor, Izquierdo and Fofack (2002). Each of these papers sets out a possible theoretical system in which the interlinkages between macroeconomic variables (such as output and the price level) and the labour market can be analysed.

This study uses a system of six equations, as follows:

$$L_d = f(w, r, y) \qquad (10)$$

$$w = f(y/L, l, \ y - y^*) \qquad (11)$$

$$y = f(y_d, r, g, s) \qquad (12)$$

$$y^* = f(A, K, L) \qquad (13)$$

$$p = f(p^e, wL / y, y - y^*) \qquad (14)$$

$$r = f(p^e, y - y^*, i^* + i_r) \qquad (15)$$

Each equation in the system is discussed in more detail below.

Equation 1: Demand for labour

The demand for labour equation follows the literature above, and specifies the demand equation as follows:

$$L_d = f(w, r, y) \qquad (10)$$

where L_d is labour demand, w is the real wage, r is the user cost of capital and y is output.

Equation 2: Wages

Structural labour market rigidities are generally regarded as impacting on wage determination first, and then the wage effects have so-called 'second-round effects' (e.g. on prices and output coming about as a result of the pressure on wages). Following Layard *et al* (1996), Fallon and Lucas (1996) and Wakeford (2003) wages are determined as follows:

$$w = f(y/L, l, y - y^*) \qquad (11)$$

where w is, as before, the real wage, y/L is output per worker, l, is a measure of structural factors and $y - y^*$ is the 'output gap', which functions as a measure of economy-wide capacity utilisation (see below).

Equation 3: Aggregate Demand

The key contribution that this paper wishes to make is to specify demand as a function of wages, to capture 'feedback' effects. For example, should wages increase, it can be expected that aggregate demand will increase too, at least in the short-run. In essence, aggregate demand is modelled here in a reduced form version of the well-known demand identity, $C + I + G + X - M$. Aggregate demand is thus regarded as a function of disposable income, y_d, (which affects consumption), the interest rate, r, (which affects both consumption and investment), government spending, g, (which is taken as exogenous), external demand, y^*, and the trade-weighted real exchange rate, s, (which both affect the trade balance). Thus:

$$y = f(y_d, r, g, y^*, s) \qquad (12)$$

Equation 4: Trend / Potential Output

Trend or potential output is modelled following Burrows and Smit (1999). A standard Cobb-Douglas production function (see Prescott, 2002 and Du Toit and De Wet, 2002) and is fitted to a measure of trend GDP. In this case an HP filter is used. Formally:

$$y^* = f(A, K, L) \qquad (13)$$

where y^* is trend GDP, A is total factor productivity, K is the stock of capital and L is labour flows (see Thomas 1993: 304 *et seq* for a discussion of estimation problems with aggregate level production functions).

Equation 5: Prices

The price-level is estimated following a simplified version of Aron *et al* (2003). Following Fletcher (2003), economic agents use an adaptive expectations framework, and unit labour costs, wL / y, and the output gap, $y - y^*$, also influence price-setting behaviour.

$$p = f(p^e, wL / y, y - y^*) \qquad (14)$$

Equation 6: Interest rate

Under an inflation-rate targeting framework, the interest rate is endogenously determined. Here the interest rate is determined according to a standard forward-looking Taylor rule, where the nominal interest rate, $r + \dot{p}$, is a function of inflation expectations, p^e, the output gap, $y - y^*$, world interest rates, i^*, and the South African risk premium, i_r, that is:

$$r + \dot{p} = f(p^e, y - y^*, i^* + i_r) \qquad (15)$$

(For a more detailed discussion of the components of South African interest rates see Grandes *et al*, 2003).

Estimated equations

Demand for labour equation

Recall equation (10) from the system of equations above:

$$L_d = f(w, r, y) \qquad (10)$$

Following from the above, a standard inverted production function is used (cf. Fields *et al*, 1996, and Fedderke and Marrioti, 2002) as follows:

$$l = b_0 + b_1 w + b_2 r + b_3 q$$

where l is the number of workers, w is the real wage rate, r is a measure of the cost of capital and q is a measure of output or gross-value added.

A priori, one would expect that the coefficient on the real wage term would be negative, positive on the output term and ambiguous on the interest rate term.

The summary econometric tests reported in the table (R-squared, adjusted R-squared, standard error of regression etc.) indicate that the results are econometrically robust.

There is also evidence that the long-run portion of the regression cointegrates. This test by using a standard Johansen test (see Harris, 1995). The results of the summary Johansen test using all six assumptions on the nature of the intercept and trend are presented in the table below. The results show that there is one co-integrating relationship, assuming no intercept and no linear trend or assuming an intercept and no linear trend or assuming a quadratic intercept and trend. The Granger causality test presented above shows that the direction of causation is real wages to employment, output to employment. The employment to output relationship will be dealt within the context of the structural model, as discussed above.

TABLE 2: Estimated equation - number employed (formal, non-agricultural private sector)

Sample period:	1980Q1 to 2003Q2
Observations	94
Dependent variable ***Log*(Employed in millions)**	
Long-run	
Error-correction: *Log*(Employed, million $_{t-1}$)	-0.141** (-0.03)
Log(Real wage rate $_{t-1}$)	-0.099** (0.03)
Log(Real GDP $_{t-1}$)	0.117** (0.04)
Trend (1980Q2 = 1)	-0.0003** (0)
(User cost of capital$_{t-1}$)	0.034** (0.03)
Calculations	
Long-run elasticity:	
Real wages	-0.702
Real GDP	0.830
User cost of capital	0.241
Half life calculation (quarters)	3.5
Constant	-0.311 ** (0.23)
Dynamics	
DLog(Real wage rate)	-0.288** (0.04)
DLog(Real GDP)	0.334** (0.08)
Impulse dummy 1995Q2	0.031** (0.01)
R-squared	0.710645
Adjusted R-squared	0.683411
S.E. of regression	0.005719
Durbin-Watson stat	2.357610
ARCH test (prob)	0.403282
Normality of residuals (prob)	0.099322

TABLE 3: Johansen co-integration test – demand for labour equation

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept	Intercept	Intercept	Intercept	Intercept
	No Trend	No Trend	No Trend	Trend	Trend
Trace	2	2	1	1	1
Max-Eig	2	2	1	1	1

*Critical values based on MacKinnon-Haug-Michelis (1999)

TABLE 4: Granger (1969) causality test – demand for labour equation

Null Hypothesis:	Obs	F-Statistic	Probability
LOG(REAL WAGE RATE) does not Granger Cause LOG(PRIVATE SECTOR EMPLOYMENT)	96	9.84296	1.1E-05
LOG(PRIVATE SECTOR EMPLOYMENT) does not Granger Cause LOG(REAL WAGE RATE)		0.80653	0.49352
LOG(REAL OUTPUT) does not Granger Cause LOG(PRIVATE SECTOR EMPLOYMENT)	96	10.3871	6.3E-06
LOG(PRIVATE SECTOR EMPLOYMENT) does not Granger Cause LOG(REAL OUTPUT)		5.98809	0.00092
COST OF CAPITAL/100 does not Granger Cause LOG(PRIVATE SECTOR EMPLOYMENT)	96	6.92826	0.00030
LOG(PRIVATE SECTOR EMPLOYMENT) does not Granger Cause COST OF CAPITAL/100		0.16506	0.91965
LOG(REAL OUTPUT) does not Granger Cause LOG(REAL WAGE RATE)	96	0.23484	0.87187
LOG(REAL WAGE RATE) does not Granger Cause LOG(REAL OUTPUT)		2.90416	0.03916
COST OF CAPITAL/100 does not Granger Cause LOG(REAL WAGE RATE)	96	0.39720	0.75533
LOG(REAL WAGE RATE) does not Granger Cause COST OF CAPITAL/100		0.47690	0.69916
COST OF CAPITAL/100 does not Granger Cause LOG(REAL OUTPUT)	96	1.48998	0.22273
LOG(REAL OUTPUT) does not Granger Cause COST OF CAPITAL/100		1.55475	0.20601

Real wage rate equation

a. Theory revisted

The theoretical basis for the wage rate equation is taken from Layard *et al* (1992). They propose that the way in which nominal wages are determined can be represented as follows:

$$w_i = l\,[p_i - b_{01} + b_2 a\,(k_i - n_{i-1})] + (1-l)(w^e + c_0 - c_i u - c_2 \Delta u + c_3 \hat{z}_w) + \hat{z}_{1w}$$

where reflects the degree of unionisation. The first half of the equation then reflects the 'insiders', who make up a proportion equal to of the workforce. Within this half, p is the price index, b_{01} is the wage that would tend, on average, to stabilise employment for the insiders, i.e. the wage is high enough to ensure that the insiders keep their jobs. The insider wage is also negatively affected by last period's employment of insiders because the more insiders there are, the less upward pressure they can exert on wages without fearing job loss.

The second half reflects the wage paid to the outsiders, who make up a proportion of (1 - λ) of the workforce. For these workers, the market clears and their wages are determined by both the level of, and changes in, unemployment. In the equation, u is the aggregate unemployment rate, w the aggregate wage and $\hat{z}_w$ reflects other factors that may affect the outsider wage, such as the generosity and coverage of unemployment benefits.

The final variable is $\hat{z}_{1w}$ which reflects other exogenous factors that could possibly influence wages.

Given the historically strong role of unions in South Africa (see above), the deflator that is used is the personal consumption deflator reflecting that workers will negotiate on the basis of changes to their purchasing power.

b. Estimation and results

Given the data constraints, implementing a theoretical model such as that above is clearly somewhat complex. The table presents one particular estimations. The sample period is the longest possible, given that a series for mandays lost is only available back to 1986.

In the long-run, it was found that only output per worker is significant. This is consistent with the results of Wakeford (2003). The difference is that Wakeford estimated that output per worker had a long-run elasticity closer to 0.5, whilst these results indicate a statistically-significant result robust across different specifications of approximately 0.74. That is to say that a one per cent increase in labour productivity will lead in the long-run to a 0.74 per cent rise in real wages. The only other studies reviewed which estimated wage equations, *viz.* Fallon (1992) and Fallon and Lucas

(1998) did not include output per worker in the wage equation.

The dynamics indicate that in the short-run the following variables are consistently statistically significant and robust across all specifications:

- **Output per worker**. As expected, *a priori*, a rise in output per worker is found to be significant also for short-run changes in real wages. Overall it is found that a one per cent increase in output per worker has a short-run positive effect of between 0.491 and 0.622 on the real wage.

- **Unanticipated inflation**: This variable is calculated as the (log) personal consumption deflator divided by a six-period moving average of the deflator. This was used as it has been shown that inflation-expectations tend to be close to the moving-average of past inflation (see, for example, Du Plessis and Smit 2001 or Fletcher 2003)[2].

  It is estimated that a one per cent increase in unanticipated inflation leads to a fall of between 1.6 per cent in real wages. This is somewhat higher than the results found by Fallon and Lucas (1998). One would expect that this coefficient should be close to one, because if under the strict conditions of an inflation-rate targeting regime, all inflation is fully anticipated and already 'priced-in' to the real wage.

- **Union power**. During the process of estimation, two different indicators of union power were used, *viz.* the proportion mandays lost of the total available and the proportion of unionised workers. It is found that mandays lost is the most robust measure.

Other variables that were not statistically significant / wrong sign:

- **Output gap**. Theoretically higher unemployment should lead to lower real wages, at least for the outsiders. The quality of the labour data does not really allow for unemployment to be included, so the output gap was used. The output gap is a measure of the difference between actual and potential output (see Burrows and Smit 1999). The output gap is found to be not significant in the long run and only significant at the 10 per cent level in the dynamics when lagged. It is also then has the wrong sign. This gives some support to Wakeford's (2003) finding that unemployment is not a statistically significant determinant of real wages, but cannot be regarded as conclusive.

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[2] Fletcher (2003) compared different CPIX moving averages to the Bureau of Economic Research inflation expectations survey and found there is evidence of a correlation. This indicates that inflation expectations are broadly backward looking. As this survey's data does not stretch back long enough to make it viable for use in this paper, the moving average of past CPIX inflation is used as a proxy for inflation expectations (cf. Fair 1984).

- **Other structural breaks**. Wakeford (2003) suggests that there should be a structural break in 1990. It is not found to be significant for the real wage equation. It was, however, significant for the demand for labour equation above.

TABLE 5: Estimated equation – real wage rate

Sample period	1993Q1 to 2002Q4
No of observations	40
Dependent variable: ***Log*(Real wage rate)**	
Log(Real wages $_{t-1}$)	-0.473** (0.11)
Log(Output per worker $_{t-1}$)	0.366** (0.09)
Log(Unanticipated inflation)	-0.775** (0.17)
Calculated	
Long-run elasticity	
Output per worker	0.744
Unanticipated inflation	1.638
Half-life (quarters)	1.057
Constant	0.860** (0.20)
Dynamics	
Δ*Log*(Output per worker)	0.964** (0.16)
Δ*Log*(Proportion mandays lost)	0.001** (0)
Impulse dummy 1996Q1	-0.037** (0.01)
R-squared	0.755781
Adjusted R-squared	0.711377
S.E. of regression	0.010071
Durbin-Watson stat	2.206790
ARCH test (prob)	0.402640

TABLE 6: Johansen co-integration test – real wage rate equation

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	2	1	1	1	1
Max-Eig	1	1	1	1	1

TABLE 7: Granger (1969) causality tests – real wage rate equation

Null Hypothesis:	Obs	F-Statistic	Probability
LOG(LPRODP(-1)) does not Granger Cause LOG(REAL WAGE RATE)	44	4.70848	0.00698
LOG(REAL WAGE RATE) does not Granger Cause LOG(LPRODP(-1))		0.44848	0.71985
LOG(PCPI/@MOVAV(PCPI,4)) does not Granger Cause LOG(REAL WAGE RATE)	44	9.00148	0.00013
LOG(REAL WAGE RATE) does not Granger Cause LOG(PCPI/@MOVAV(PCPI,4))		2.37768	0.08548
LOG(PCPI/@MOVAV(PCPI,4)) does not Granger Cause LOG(LPRODP(-1))	44	5.13660	0.00453
LOG(LPRODP(-1)) does not Granger Cause LOG(PCPI/@MOVAV(PCPI,4))		2.51920	0.07294

Equation 3 - Aggregate demand

As indicated above, this study uses a standard reduced form equation to estimate aggregate demand, as follows:

$$y = f(y_d, r, G, y^*, s)$$

where y_d is disposable income, which is defined as the wage bill (*w.L)* less taxes plus net transfers, r is as above the real interest rate, y^* is foreign demand and s is the real trade-weighted exchange rate.

A priori, one would expect that disposable income would have a significant, large and positive effect on aggregate demand. The real interest rate should have a negative coefficient. Government consumption expenditure, which is regarded as exogenous, should have a positive effect, but most studies expect that this effect will only be a short-run one (see National Treasury, 2003: 56). External demand has an effect on the trade balance, and should be positive, reflecting the stylised fact that an increase in foreign demand will have a positive effect on exports. Here external demand is proxied by an index of the weighted average of output of the G7 countries. Finally, the effect of the trade-weighted real exchange rate is expected to be negative. An appreciation of the domestic currency against other currencies should cause a deterioration of the trade balance, due to an increase in imports, a decline in exports or both.

The coefficients are as expected. In the long-run, a one per cent rise in disposable on income has the greatest effect on output, which is estimated to rise by 0.544 per cent. An increase in the real prime rate by one percentage point decreases output by 0.16 per cent, a one per cent appreciation of the real trade-weighted exchange rate causes output to fall by almost 0.1 per cent and a one per cent rise in the output of the G7 countries causes domestic output to rise 0.267 per cent. The only additional variable that is significant in the short-run is government consumption spending, which is beneficial for output. It was not found to be significant in the long-run, however, which is in line with the majority of the literature.

TABLE 8: Estimated equation – aggregate demand

Sample period	1990Q2 to 2003Q4
No of observations	
Dependent variable *DLog*(Real output)	
Long-run	
Log(Real output$_{t-1}$)	-0.206** (0.04)
Log(Real disposable income$_{t-1}$)	0.112** (0.04)
Real prime rate $_{t-1}$	-0.033** (0.01)
Log(Trade-weighted real exchange rate$_{t-1}$)	-0.019** (0.01)
Log(G7 output)	0.055* (0.03)
Calculated	
Long-run elasticity	
Real disposable income	0.544
Real prime rate	-0.160
Trade-weighted real exchange rate	-0.092
G7 output	0.267
Half-life (quarters)	4.9
Constant	1.646** (0.29)
Dynamics	
DLog(Real government consumption spending)	0.087** (0.03)
DLog(Real G7 output$_{t-1}$)	0.436** (0.13)
Impulse dummy 1992	-0.014** (0.001)
Impulse dummy 1994Q1	-0.013** (0.003)
DLog(Real disposable income)	0.127** (0.05)
DLog(Trade-weighted real exchange rate)	-0.021** (0.01)
R-squared	0.817459
Adjusted R-squared	0.770763
S.E. of regression	0.003016
Durbin-Watson stat	1.630651
ARCH test (prob)	0.807398
Normality of residuals (prob)	0.092334

Equation 4 - Trend GDP

For the purposes of the analysis here, trend GDP is not explicitly modelled. A simple Hodrick-Prescott filter was fitted to the historical GDP data to get an estimate of underlying trend GDP.

Equation 5 - Prices

As indicated above, prices are modelled as being a function of adaptive price expectations, unit labour costs and the output gap.

$$p = f(p^e, wL / y, y - y^*) \qquad (14)$$

A priori one expects a very strong and significant relations relationship between the adaptive expectations term and prices. In this case, adaptive expectations are modelled as being the trailing four-quarter moving average of the consumer price index. In the long-run, it is found that a one per cent increase in price expectations leads to a 0.89 per cent increase in the consumer price index. A one per cent appreciation of the real trade-weighted exchange rate leads to a fall of approximately 0.3 per cent in the consumer price index, whilst a similar rise in unit labour costs leads to a rise of 0.101 per cent in the index.

In the ECM, the only additional variable that is included is the output gap, which is not included in the long-run because the variable is I(0). A dummy variable for the Asian crisis (third quarter of 1998) is included and a lagged dependent term to capture inflation hysterisis.

TABLE 9: Estimated equation – consumer price index

Sample period	1990Q2 to 2003Q4
No of observations	55
Dependent variable *DLog*(Consumer price index$_{t-1}$)	
Long-run	
Log(Consumer price index$_{t-1}$)	-0.883** (0.15)
Log(Price expectations index$_{t-1}$)	0.786** (0.16)
Log(Real effective exchange rate$_{t-1}$)	-0.026** (0.01)
Log(Unit labour cost$_{t-1}$)	0.089** (0.03)
Calculated	
Long-run elasticities	
Price expectations index	0.890
Real effective exchange rate	-0.294
Unit labour cost	0.101
Half-life (quarters)	0.57
Constant	0.214** (0.07)
Dynamics	
DLog(Price expectations index)	2.689** (0.26)
DLog(Output$_{t-1}$)/Trend output$_{t-1}$)	0.372** (0.11)
Impulse dummy 1998Q3	0.013** (0.004)
DLog(Consumer price index$_{t-2}$)	-0.389** (0.10)
R-squared	0.905000
Adjusted R-squared	0.888478
S.E. of regression	0.003977
Durbin-Watson stat	1.693192
ARCH (prob)	0.290790
Normality of residuals (prob)	0.000000

TABLE 10: Johansen co-integration test – consumer price index equation

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept	Intercept	Intercept	Intercept	Intercept
	No Trend	No Trend	No Trend	Trend	Trend
Trace	2	1	1	1	1
Max-Eig	1	1	1	1	1

TABLE 11: Granger (1969) causality test – consumer price index equation

Null Hypothesis:	Obs	F-Statistic	Probability
LOG(PEXP_ADAPT(-1)) does not Granger Cause LOG(PCPI(-1))	20	2.53033	0.11300
LOG(PCPI(-1)) does not Granger Cause LOG(PEXP_ADAPT(-1))		13.4381	0.00045
LOG(REXEFR(-1)) does not Granger Cause LOG(PCPI(-1))	20	1.14832	0.34354
LOG(PCPI(-1)) does not Granger Cause LOG(REXEFR(-1))		2.80479	0.09229
LOG(ULCT(-1)) does not Granger Cause LOG(PCPI(-1))	20	0.58163	0.57111
LOG(PCPI(-1)) does not Granger Cause LOG(ULCT(-1))		1.91730	0.18135
LOG(REXEFR(-1)) does not Granger Cause LOG(PEXP_ADAPT(-1))	20	1.30173	0.30109
LOG(PEXP_ADAPT(-1)) does not Granger Cause LOG(REXEFR(-1))		2.24892	0.13989
LOG(ULCT(-1)) does not Granger Cause LOG(PEXP_ADAPT(-1))	20	1.10550	0.35657
LOG(PEXP_ADAPT(-1)) does not Granger Cause LOG(ULCT(-1))		1.68251	0.21915
LOG(ULCT(-1)) does not Granger Cause LOG(REXEFR(-1))	20	3.35562	0.06245
LOG(REXEFR(-1)) does not Granger Cause LOG(ULCT(-1))		2.19571	0.14575

Equation 6 - Taylor rule

Here, the Taylor rule is specified in identity form as being a function of the previous repo rate, a foreign interest rate (in this case the European BA rate), the risk premium, deviations of the CPIX inflation rate from the mid-point of the target, and the ratio of output to trend output. It is assumed that the Reserve Bank places regards inflationary pressure as more important than output deviations.

Repo rate = 0.5*Repo rate$_{t-1}$ + 0.5*[(Euro BA rate + Risk premium + 1.5*(CPIX inflation rate - 4.5) + 0.5*(Output/Trend output)] + 0.024

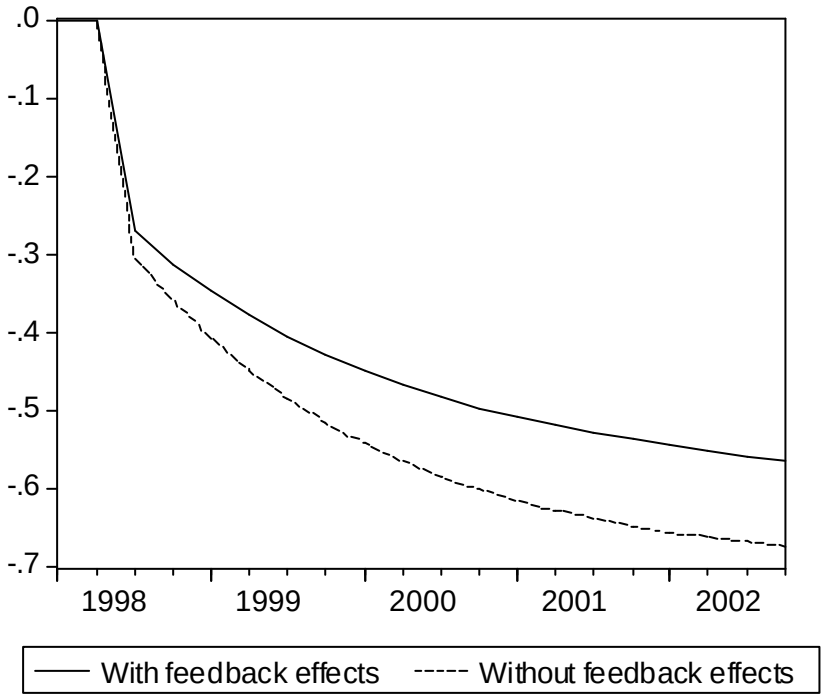
This completes the small model of the economy.

Testing for feedback effects

Given that a small model of the economy has been estimated, it can now be used to test what the potential existence of feedback effects.

The first simulation that is undertaken is to consider the effect of an exogenous increase in real wages of one per cent. The simulated effect of this increase is presented in Figure 1.

FIGURE 1: Effect on the demand for labour – increase in real wages of one percent



The solid line represents the path of adjustment. There is an initial fall (as a result of the term in the short-run part of the equation). Thereafter, the path to equilibrium differs between the two approaches. Without feedback effects, the path gradually tends to the long-run elasticity as calculated above (-0.7). With feedback effects, a slightly higher new equilibrium is reached. The new equilibrium is explained by the increase in demand that comes about as a result of the increase in disposable income. This increase in growth is shown in Figure 2.

FIGURE 2: Effect on GDP growth – increase in real wages of one percent

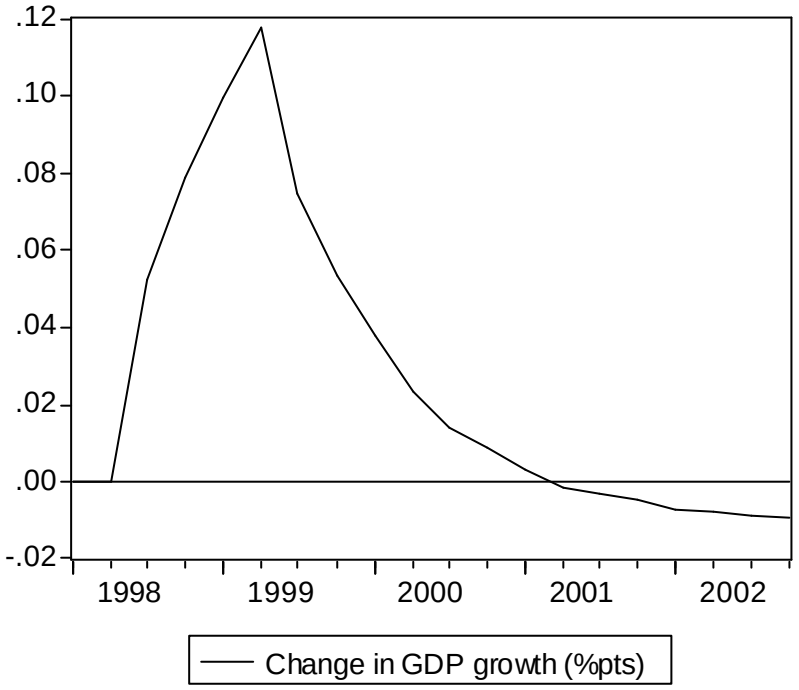
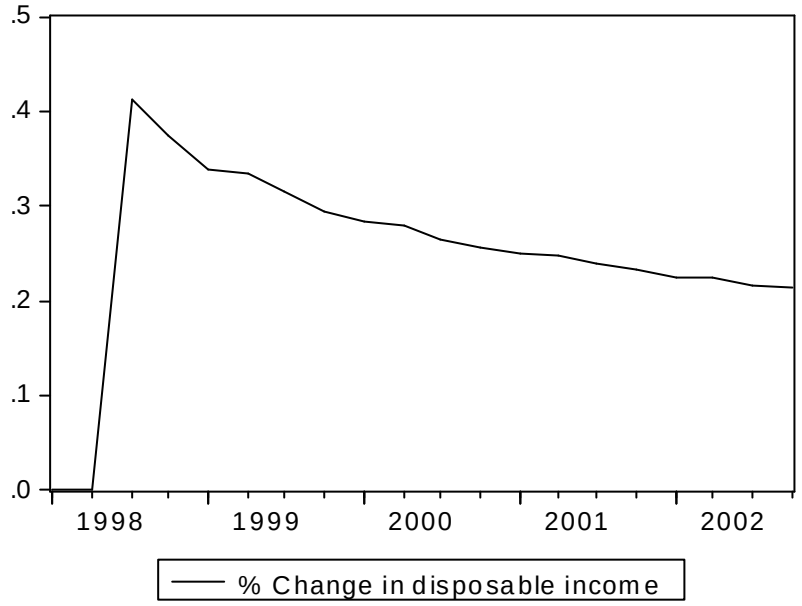


FIGURE 3: Effect on disposable income – increase in real wages of one percent

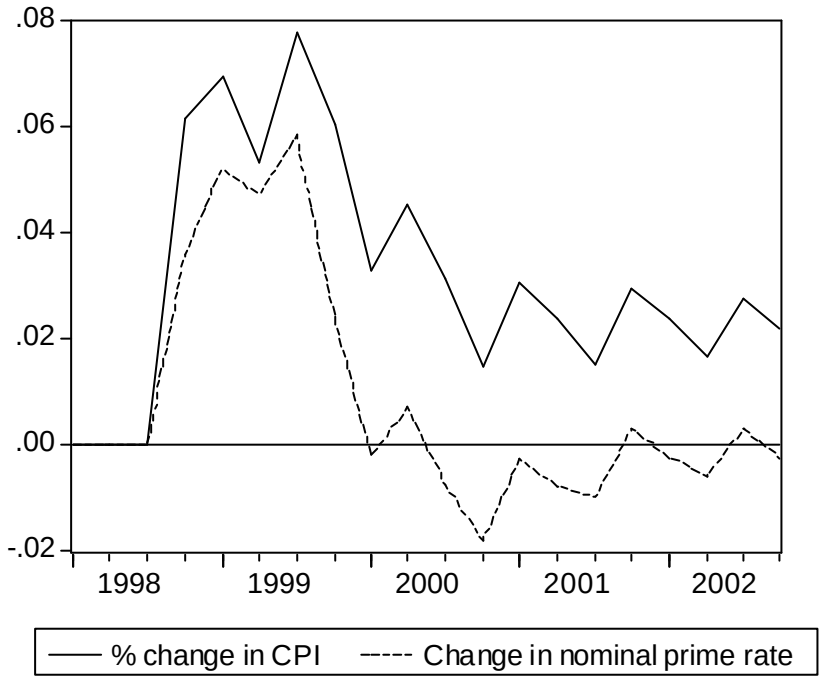


The change in disposable income peaks immediately and is then gradually eroded as job losses begin to outweigh the effect of the rise in wages. Importantly, disposable income does not increase by the same magnitude as the increase in real wages. This is because of offsetting job losses.

The pass through to output is relatively small. This is because the increase in real wages is inflationary (

FIGURE 4) and consequently the Reserve Bank acts to increase the repo rate, which in turn dampens domestic demand slightly.

FIGURE 4: Change in inflation and prime rate – increase in real wages of one percent

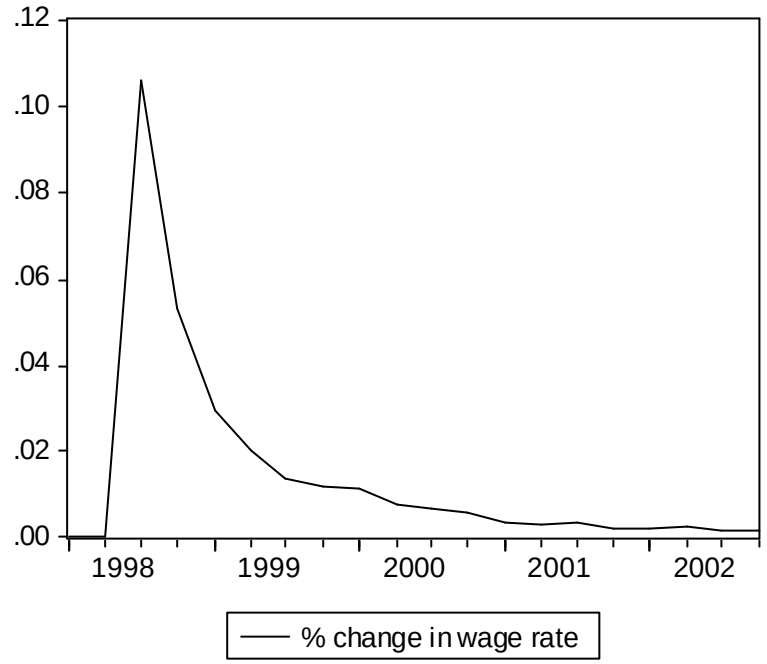


Insiders and outsiders

The second criticism of the literature relates to accounting for understanding labour market rigidities. In this section, we test what the effect would be of a doubling the number of mandays lost over the sample period, as a proxy for estimating the effect of insiders and outsiders.

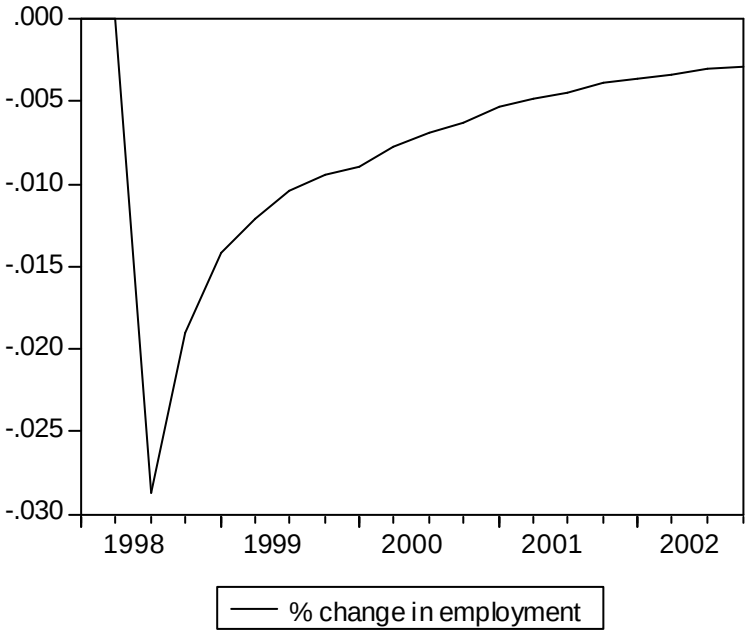
The effects are as expected. First there is a rise in the real wage rate as workers successfully increase their real wage (Figure 5).

FIGURE 5: Change in wage rate – increase in mandays lost



The increase in the wage rate comes with a corresponding fall in the demand for labour, as is shown in Figure 6.

FIGURE 6: Change in employment – increase in mandays lost



Other rigidities

It is possible to fully account for the other structural rigidities that theory proposes. Wakeford (2003), for example, uses the co-integration properties of some the data to test for causation between variables. This allows him to get a sense of whether the efficiency wage hypothesis holds (i.e. that a rise in real wages leads to an increase in productivity). He finds that this is not the case. This is also the finding here (see Table 7). Search-and-matching models are particularly difficult to implement within a macroeconomic framework. Within a simple model such as this is also difficult to fully account for wage rigidities, although to some extent this is captured by the estimation of unanticipated inflation.

The difficulties related to incorporating different labour market theories within the context of a single empirical model lends credibility to Pagan's (2003) concept of a trade-off between empirical and theoretical coherence. Even if it were possible, as Hamermesh (1999) suggests, labour data are always 'dirty' making it difficult to fully account for data concerns.

It would seem that it is impossible to both:

- capture all the theoretical determinants of the demand for labour in a quantifiable way (a "quantification problem"); and
- explain the identified empirical relationships through the lens of theory (a "qualification problem").

Conclusion

Even accounting for feedback effects, it is clear that rising real wages contribute to falling employment. As such, an increase in real wages tends to distribute income in favour of wage earners over the unemployed. An increase in wages is also only beneficial to the economy in the short run, and the benefits are gradually eroded by rising inflation and interest rates. There is no free lunch. Union power is shown to also have similar effects, mainly because an increase in the exercise of union power (proxied by mandays lost) tends to cause higher real wages.

The other finding of the paper is a somewhat philosophical one. 'Structuralist' labour market theories, such as wage rigidity, insider-outsiders, efficiency wages and search-and-matching models are difficult to incorporate within the context of a single econometric model. Some insight can, however, be gained from separately estimating some of these effects. In this paper, the role of insiders and outsiders was incorporated by considering a wage function that included a term for the exercise of union power.

The difficulty of reconciling theory and empirics lends support to the ‘Pagan curve’, Pagan (2002)’s stylised representation of the inherent trade-off between theoretical and empircal coherence. Forming a complete picture of how the labour market functions requires both empirical and theoretical insights. It seems our understanding of the demand for labour is indeed a casualty of the Pagan curve.

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