# The Demand for Labour in South Africa

## A THEORETICAL AND EMPIRICAL APPROACH

Roy Charles Havemann

Thesis completed in partial fulfillment of the requirements for the degree
MASTER OF COMMERCE (ECONOMICS)
at the University of Stellenbosch.

Supervisor: Prof. Servaas van der Berg

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# Declaration

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and that I have not previously in its entirety or in part submitted it at any university for a degree.

Date: 9 March 2004

# Abstract

Nearly five million South Africans were unemployed in 2002 and creating employment opportunities is a difficult challenge. Before this issue can be tackled, however, it is critical to understand the problem. This thesis opts to contribute to this understanding by considering aspects around the demand for labour. The analysis considers a selection of the theoretical literature on the demand for labour, estimates key labour market parameters and then undertakes a number of simulations using a structural model.

There are many conflicting paradigms that can be used to analyse the issue: microeconomic versus macroeconomic; neoclassical versus structuralist; theoretical versus empirical and so forth. Some of these paradigms are considered as part of the attempt to build an empirical framework that can be used to analyse the issue.

The empirical results of the thesis suggest that:

- Higher real wages lead to lowering of the quantity demanded of labour. The thesis estimates an economy-wide wage elasticity of employment of approximately -0,67;
- Higher output stimulates the demand for labour. The single equation estimate of the employment elasticity of output is between 0,66 and 0,75, whilst the economy-wide estimate is approximately 1,1. The latter takes into account feedback effects from other macroeconomic variables, such as productivity and wages;
- There is little evidence to show that the efficiency wage hypothesis holds – higher productivity leads to higher wages, but the converse is not true;
- Union power increases real wages, indirectly leading to a fall in the demand for labour. This suggests that the labour market has insiders and outsiders; and
- The relative price of labour is also important, with a fall in the cost of capital leading to a decrease in the demand for labour.

Simulations suggest that job creation can be achieved through policies that encourage wage moderation and increase economic growth. There is also a potential role, albeit limited, for fiscal incentives such as a mooted earned income tax credit.

# Opsomming

Byna vyf miljoen Suid-Afrikaners was werkloos in 2002 en werkskepping is 'n moeilike uitdaging. Voordat hierdie kwessie aangepak kan word, is dit egter noodsaaklik om die probleem te verstaan. Hierdie tesis dra by tot hierdie begrip deur te fokus op punte rondom die vraag na arbeid. Die ontleding kyk na 'n verskeidenheid van teoretiese literatuur oor die vraag na arbeid en identifiseer sleutel-parameters vir die arbeidsmark.

Daar is soveel teenstrydige paradigmas wat gebruik kan word om die kwessie te ontleed: Mikro-ekonomies teenoor makro-ekonomies; neoklassiek teenoor strukturalisties; teoreties teenoor empiries, ensovoorts. Sommige van hierdie paradigmas word bespreek as deel van die poging om 'n empiriese raamwerk te bou wat gebruik kan word om die kwessie te ontleed.

Die empiriese resultate van die tesis toon:

- Hoër reële lone lei tot 'n verlaging van die hoeveelheid arbeid aangevra. Die tesis beraam die ekonomiewye loonelastisiteit van indiensneming op sowat -0,67;
- Hoër uitset stimuleer die vraag na arbeid. Die enkelvergelyking-raming van die uitset-elastisiteit van indiensneming is tussen 0,66 en 0,75, terwyl die ekonomiewye raming sowat 1,1 is. Laasgenoemde neem terugvoerinvloede van ander makro-ekonomiese veranderlikes in ag, bv. produktiwiteit en lone.
- Daar is min bewyse dat die doeltreffende loon-hipotese water hou: Hoër produktiwiteit lei tot hoër lone, maar die teendeel is onwaar;
- Vakbonde se mag verhoog reële lone, wat indirek lei tot 'n daling van die vraag na arbeid. Dit dui daarop dat die arbeidsmark 'n binnekring en buitestaanders het; en
- Die relatiewe prys van arbeid is ook belangrik: 'n Afname van die koste van kapitaal veroorsaak 'n daling van die vraag na arbeid.

Simulasies toon dat werkskepping bevorder kan word deur beleid wat loonmatiging en ekonomiese groei bevorder. Daar is ook 'n rol, alhoewel beperk, vir fiskale insentiewe, b.v. 'n loonsubsidie.

# Acknowledgements

There are a number of people who have contributed in some way to this thesis. My supervisor, Prof. Servaas van der Berg, was a patient and understanding source of constant encouragement. He endured my somewhat unorthodox style of periodic spurts of productivity, abrupt revisions and sudden ideas without any complaint and, as always, kept me on track. My colleagues at the National Treasury, in particular Kevin Fletcher and Elias Masilela, provided the original inspiration for much of the thesis and then were also excellent sounding boards, and sometimes sources, for my ideas. Martina Smit provided an Afrikaans abstract and Isabel Kilian helped with some of the typing. My family and girlfriend gave moral support and encouragement and were particularly understanding in the final stages. Finally, I would also like to thank the colourful characters that make up the group of South African labour economists for providing so much contradictory policy advice to review, discuss and think about. The remaining errors are my own.

SOLI DEO GLORIA

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# Chapter 1: Introduction

*No man has hired us*
*With pocketed hands*
*And lowered faces*
*We stand about in open places*
*And shiver in unlit rooms...*

*No man has hired us.*
*Our life is unwelcome*
*Our death unmentioned in* The Times

TS Eliot, *Choruses from The Rock* I

## 1.1. Background

Three things have characterised the South African economy between 1994 and 2003: sound macroeconomic management, consistent growth (albeit moderate) and relatively stable labour relations. These three things, however, have not translated into employment generation. Given economic inequality and persistent poverty, South Africa cannot afford to allow this situation to continue. In the September 2002 Labour Force Survey, Statistics South Africa (2002b) estimated that 4,6 million South Africans were classified as unemployed by the official, narrow definition.

Raising levels of employment is one of South Africa's greatest challenges. From an economic point of view, the large numbers of unemployed citizens represent significant untapped potential. From a social point of view, some of the unemployed may resort to crime, alcohol and drugs in an attempt to alleviate grinding poverty. From a political point of view, a recent survey by the Bureau for Market Research (2003) showed that job security tops the list of voter concerns.

There are no simple policy solutions to the problem and it is an extraordinarily complex problem. Unemployment by the official measure – those actively seeking work – has risen over the past number of decades for a number of reasons. It would appear that one of these is an increase in the labour force participation rate. In this regard, South Africa may be a victim of its own economic success – labour force participation is increasing as economic opportunity increases. Unfortunately, the supply of labour is beyond the scope of this thesis. The paper limits itself to understanding the demand for labour, which is only one aspect of the problem.

Although the number of those actively seeking work has risen, many have also withdrawn from the labour market, discouraged by their inability to find work. StatsSA (2002b) estimates that there are approximately 3 million discouraged workers. There is much debate in academic circles[1] on whether or not these individuals should be counted as 'unemployed', but ultimately it does not matter much – the economy is still not absorbing workers.

## 1.2. The labour demand approach

It is, as noted, a complex issue. This thesis does not attempt to give a seminal overview of the issue, nor does it hope to point out a definitive solution. Its aims are rather modest. This is not a policy analysis *per se*, rather the work aims to provide theoretical and empirical backdrop to the problem as part of a broader policy process.

It tackles the issue from the perspective of the demand for labour. What determines the demand for workers? Given that there is stable economic growth, why does the labour market not absorb (or require) additional workers? Does the labour market not function optimally? If not, why not? These are some of the questions touched on in the analysis.

## 1.3. Structure of the thesis

The thesis considers three facets of the issue and this informs the structure of the thesis.

Part I deals with the functioning of a labour market at the microeconomic level. It has three chapters. Chapter 2 outlines the neoclassical model of the labour market – the benchmark, perfectly functioning system in which all that wish to work can. High unemployment is, however, an empirical fact that needs to be explained. The chapter that follows develops the neoclassical model somewhat to allow for unemployment. A number of theories are considered, including those of John Maynard Keynes (disequilibria), Leibenstein, Stiglitz and Solow (efficiency wages), Mortensen and

Pissarides (search-and-matching) and Lindbeck, Snower, Blanchard and Summers (insider-outsiders). Chapter 4 closes the microeconomic analysis with an overview of how these theories have been applied (and sometimes misapplied) to the South African policy debate.

Part II then briefly develops the issue from a macroeconomic point of view. It follows a similar pattern. First the standard model is considered – this is done in chapter 5 by aggregating the neoclassical production function of chapter 2 to the macroeconomic level. Chapter 6 sets out three theoretical models of how a labour market functions at the macroeconomic level – by Blanchard and Fischer; Layard, Nickell and Jackman; and Agénor, Izquierdo and Fofack. The macroeconomic analysis then closes by considering some of the recent empirical literature in chapter 7.

This empirical work reviewed at the end of Part II provides the background for the author's own attempt at an empirical analysis in Part III. The constraints of the data notwithstanding, a small two-equation model of the South African labour market is built. The methodology used is discussed in chapter 8, the data constraints in chapter 9 and the results in chapter 10. In chapter 11, this model is then incorporated into the National Treasury's quarterly structural macroeconomic model to try and better understand the linkages between the labour market and the rest of the macroeconomy.

For the empirical work, a time-series approach is chosen. This is because the literature, international and domestic, focuses heavily on cross-sectional econometrics. Hamermesh (1999) notes that the percentage of time-series labour market papers in the *American Economic Review* fell from 57 per cent during the period 1967 to 1992 to 33 per cent between 1992 and 1996. In the South African context, Fedderke and Mariotti (2002) also note that time-series work on the labour market is somewhat thin. Given long lags in policy formulation and implementation, it is crucial to be able to understand how labour market variables interact over time, rather than at a particular point.

The overall findings of the thesis are that both neoclassical and structuralist approaches to labour market analysis provide an insight into how the South African

[1] See for example Kingdon and Knight (2001).

labour market functions. The neoclassical model suggests that output, relative prices and adjustment costs matter. The structuralist explanations complement these narrow findings by suggesting that there may be problems with how the market functions. In particular, the labour market is complicated by the fact that the commodity involved is not a widget – the presence of rational agents may cause wages to be higher, for reasons of efficiency or because of union power. In addition, frictional unemployment may occur as a result of the market not optimally matching work opportunities to those that search for them.

The hope is that this paper will contribute to a better understanding of the factors underlying why the demand for labour in South Africa is insufficient to create work opportunities for the millions that are unemployed.

# Part I

## Microeconomic Analysis

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# Chapter 2: The Neoclassical Model of the Demand for Labour

*It is an obvious truth, but one which can bear some repetition, that labour only has an economic value and can fetch a price in the market if, and to the extent that, it can produce goods and services which are wanted by buyers who are prepared to pay a price for them whether in money or in kind.*

*J. L. Sadie (1980: 1)*

## 2.1. Introduction

How does a labour market function at the microeconomic level? This chapter begins building an answer to this question by turning to the well-established neoclassical framework. This framework does not by any means offer a complete explanation of the demand for labour. There are many limitations to the approach, the greatest of which must be that it suggests that unemployment is impossible given that all markets clear. It does, however, provide a useful starting point and the mathematical rigour also provides an excellent basis for empirical work.

## 2.2. The neoclassical static approach

The neoclassical microeconomic approach to the question of the demand for labour is well established in numerous labour economics textbooks (see, for example, Sadie 1980; Bosworth, Dawkins and Stromback 1996; Borjas 1996 or Hamermesh 1993).

Firstly it is important to identify the demand for labour as a derived demand in the tradition established by Sir Alfred Marshall in 1920: labour is not demanded for its own sake (Hamermesh 1993). The use of labour is rather seen as a means to an end – this end is the production of goods and services that satisfy the needs and desires of consumers. This establishes the first theme of this thesis – **the demand for labour is derived from the demand for end goods and services**.

To better understand how the demand for labour and the production process interact, one can turn to the production function literature.

## 2.3. The production function

Bosworth *et al* (1996: 87) define the production function as the 'link between the firm's output(s) and its consumption of various factor services'. There is thus a relationship between what the firm uses (capital, raw materials, workers) and what it produces (goods, services). When comparing firms producing similar goods and using similar inputs, it is relatively straightforward to determine the relationship between the different inputs and the result. In a large diversified economy, however, there is an enormous number of different possible combinations of inputs and outputs.

For the sake of simplicity, the inputs can be broadly classified into two groups: capital ($K$) and labour ($L$). Output ($Q$) can thus be algebraically expressed as follows:

$$Q = f(K, L) \qquad [2\text{-}1]$$

This can be represented graphically by plotting all the combinations of capital and labour that will yield an equal quantity of output[2]. This is known as the isoquant (the Greek for equal is *isos*).

The following issue is to consider how inputs are combined to form the firm's output. There are a number of standard functional forms that represent the way inputs are combined. Table 2-1 compares the most important characteristics of the four most common of these:

- the fixed coefficient;
- the Cobb-Douglas;
- the constant elasticity of substitution (CES); and
- perfect substitution production functions.

The four different approaches set out different theoretical ways of analysing how a firm combines capital and labour to form the goods and services that they eventually sell in the market. The two most commonly-used, the Cobb-Douglas and the CES production functions, will be considered in more detail in a later part of the chapter.

[2] Later, the analysis will consider introducing efficiency of the production factors and the use of technology ($A$) and how the analysis can be extended to include non-homogenous factors of production.

**Table 2-1**: Standard functional forms

| | Fixed coefficient | Cobb-Douglas | Constant elasticity of substitution | Perfect substitution |
|---|---|---|---|---|
| *Functional form* | Q=min*f*(K,L)<br>Q = aK = bL | Q = f(K,L)<br>$Q = A.K^{\alpha}.L^{\beta}$ | Q = f(K,L)<br>$Q = \delta(aK^{-\rho} + bL^{-\rho})^{-\theta/\rho}$ | Q = f(K,L)<br>Q = aK+bL |
| *Technical parameters* | a,b | A,α,β | δ, a, b, ρ, θ | a, b |
| *Isoquant shape determined by* | K = b/a L | $K = A^{-1/\alpha}Y^{1/\alpha}L^{-\beta/\alpha}$ | $K = \left[\frac{1}{a}\left(\frac{Y}{\delta}\right)^{-\rho/\theta} - \frac{b}{a}L^{-\rho}\right]^{-1/\rho}$ | $K = \frac{\overline{Y}}{a} - \frac{b}{a}L$ |
| *Isoquant* | | | | |
| *Returns to labour ($MP_L$)* | $\frac{\partial Q}{\partial L} = 0$ | $\frac{\partial Q}{\partial L} = \beta\frac{Q}{L}$ | $\frac{\partial Q}{\partial L} = \theta\delta\left[aK^{-\rho} + bL^{-\rho}\right]^{-\theta/\rho-}$ | $\frac{\partial Q}{\partial L} = b$ |
| *Returns to scale* | Constant everywhere | Decreasing for $\alpha + \beta < 1$<br>Constant for $\alpha + \beta = 1$<br>Increasing for $\alpha + \beta > 1$ | Decreasing θ < 1<br>Constant θ = 1<br>Increasing θ > 1 | |
| *Elasticity of substitution* | σ = 0 | σ = 1 | $\sigma = \frac{1}{1+\rho}$<br>= constant $0 \leq \sigma \leq \infty$ | infinite |

*Source: Bosworth (1996)*

These are the most common functional forms, but the table by no means provides a complete picture and the production function literature has advanced to also include flexible functional forms, such as the transverse logistic function.

### 2.3. (a) The capital: labour ratio equilibrium

The neoclassical model assumes that the firm strives to maximise profit. This is not necessarily true of all firms. As a result, the profit maximisation assumption can be relaxed and two additional possible goals identified (Bosworth 1996). One alternative is a firm that wants to grow market share as cheaply as possible (technically, output maximisation with a cost constraint). The second alternative is a firm that can no longer grow its market share, but still strives to become more efficient (cost minimisation with an output constraint).

These three alternative goals lead to slightly different results for equilibrium (see Bosworth *et al* 1996: 94-6).

*a. The profit-maximising firm*

In general, the long-run capital/labour equilibrium is where the isoquant makes a tangent with the budget line (see Figure 2-1). Any other points on the budget line are inefficient and are associated with lower output with the same cost. The profit maximiser will find the optimal combination of inputs by comparing all the points of tangency consistent with the following relationship:

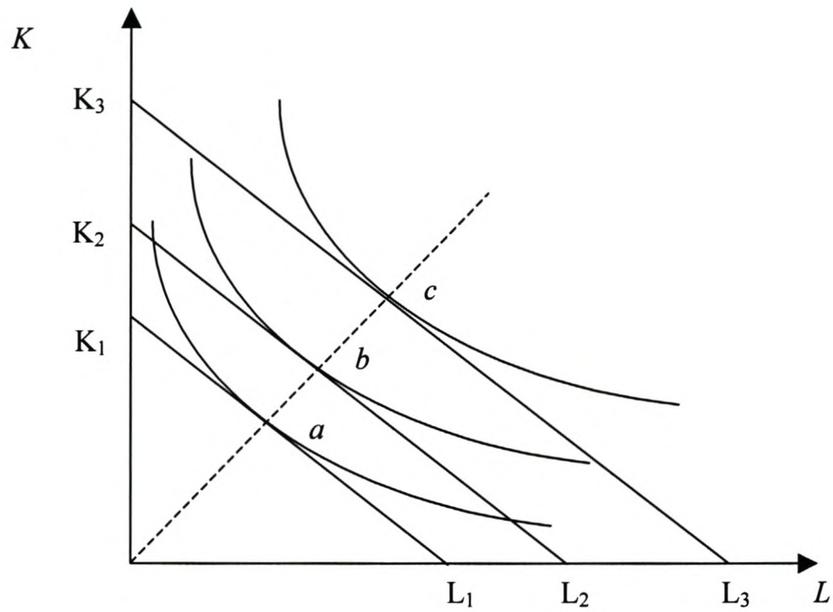
$$\frac{dK}{dL} = -\frac{MP_L}{MP_K} = -\frac{w}{r} \qquad [\,2\text{-}2\,]$$

where the ratio of the wage rate, $w$, to the 'rental' rate for capital, $r$, is equal to the ratio of the marginal product of labour ($MP_L$) to the marginal product of capital ($MP_K$). At all the possible points of tangency (in Figure 2-1, these are *a*, *b* and *c*), the entrepreneur calculates the profit level according to:

$$\Pi = pQ - (rK + wL) \qquad [\,2\text{-}3\,]$$

where profit, $\Pi$, is simply the firm's revenue (unit price, $p$, multiplied by output, $Q$) less the cost of production. The output that represents the greatest profit is the level at which the firm will produce.

**Figure 2-1**: Indifference curves for profit maximisation



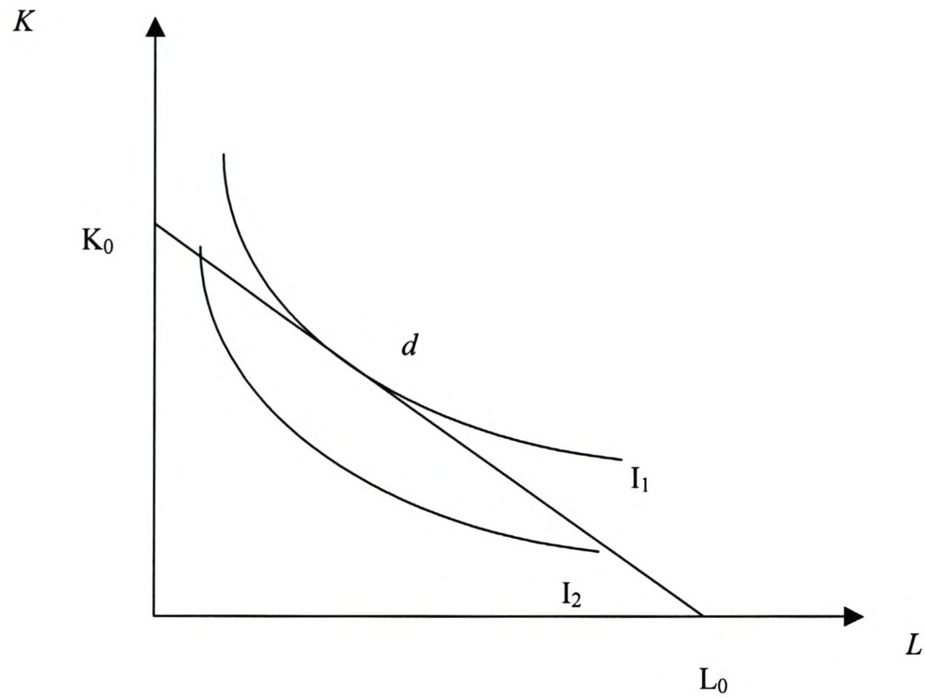

*b. Building market share (output maximisation subject to a cost constraint)*

Firms that wish to build their market share while keeping costs down will behave slightly differently (Bosworth *et al* 1996: 95). One can assume that the firm does not want to exceed a certain cost threshold, $C_1$. The budget constraint is thus:

$$K = \frac{C_1}{r} - \frac{w}{r}L \qquad [\text{2-4}]$$

The slope of the line is $-\frac{w}{r}$, the ratio of the factor prices. The firm will produce the largest possible output, which is on the highest possible indifference curve (in Figure 2-2 this is curve $I_1$).

**Figure 2-2**: Indifference curves for building market share




*c. Efficient production (Cost minimisation with an output constraint)*

It is possible that a firm could have reached the maximum possible market share in an industry or alternatively that a product is no longer as profitable as before. The firm may then set the objective of minimising costs while maintaining a certain level of output.

This graphical analysis is almost unchanged from Figure 2-2. The only difference is that the firm will now shift its budget line as close to the origin as possible to ensure that output is as cheap and efficient as possible.

## 2.4. Formal derivation of a labour demand function

Given the graphical analysis, a more formal derivation of the labour demand function can now be undertaken (adapted from Silberberg 1978, as quoted in Bosworth *et al*

1996). Assume that the firm minimises costs subject to an output constraint in a two-factor input model, i.e.:

$$c = rK + wL \quad \text{such that} \quad Y_0 = f(X_1, X_2) \qquad [2\text{-}5]$$

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

$$\text{Min } \mathcal{L} = rK + wL + \lambda(Y_0 - f(L,K)) \qquad [2\text{-}6]$$

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

$$\frac{\partial L}{\partial K} = \mathcal{L}_1 = r - \lambda f_1 = 0 \qquad [2\text{-}7]$$

$$\mathcal{L}_2 = w - \lambda f_2 = 0 \qquad [2\text{-}8]$$

$$\mathcal{L}_3 = Y_0 - f(K,L) = 0 \qquad [2\text{-}9]$$

Solving equations [2-7] to [2-9]

$$K = K(r, w, Y_0) \qquad [2\text{-}10]$$

$$L = L(w, r, Y_0) \qquad [2\text{-}11]$$

$$\lambda = \lambda(r, w, Y_0) \qquad [2\text{-}12]$$

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

$$\frac{\partial K}{\partial r} < 0; \frac{\partial K}{\partial w} > 0; \frac{\partial L}{\partial r} > 0; \frac{\partial L}{\partial w} < 0 \qquad [2\text{-}13]$$

Equation [2-13] 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.

The first theme of the thesis established that there will be demand for labour if there is a demand for the goods and services that labour produces. Equation [2-13] above introduces the second theme of the thesis: **relative prices matter**.

### 2.4. (a) In the long run

The long-run demand curve for the labour can be derived by considering the effect of a decrease in wages (Borjas 1996: 116). The analysis assumes that the firm strives to maximise profit. A drop in the wage will have two effects. The first effect is that firms will change their methods of production to favour more labour-intensive practices. This is known as a *substitution* effect. The second effect is a *scale* effect. Since labour has become cheaper, the marginal cost of production will decrease. As a result, a higher level of output can be achieved before the condition that marginal revenue equals marginal cost is met.

For a given technology, long-run employment in the firm depends on the various prices, or:

$$E_{LR} = E(w, p, r) \qquad [2\text{-}14]$$

The long-run elasticity of labour demand can be given as:

$$\delta_{LR} = \frac{\%\Delta E_{LR}}{\%\Delta w} = \frac{\Delta E_{LR}/E_{LR}}{\Delta w/w} = \frac{\Delta E_{LR}}{\Delta w}.\frac{w}{E_{LR}} \qquad [2\text{-}15]$$

The long-run labour demand curve is downward sloping and hence the long-run elasticity of labour is negative.

It has been highlighted that a fall in the wage rate will have both a substitution and scale effect. To identify the substitution effect, it is necessary to estimate the elasticity of substitution.

The extreme possibilities are that labour and capital are perfect substitutes (the capital-labour isoquant is a straight line) or that labour and capital are perfect complements (the isoquant is right-angled). Table 2-1 shows the functional forms of the production function that would correspond to these two possibilities.

In between these two extremes, there are a number of substitution possibilities. The more curved the isoquant, the smaller the size of the substitution effect.

The elasticity of substitution between capital and labour (holding output constant) is calculated as follows (Borjas 1996: 124):

$$\sigma = \left.\frac{\%\Delta(K/L)}{\%\Delta(w/r)}\right|_q \qquad [\,2\text{-}16\,]$$

## 2.5. Marshall's rules of derived demand

Alfred Marshall formulated four rules of derived demand for labour (Hamermesh 1993). These state that the demand for labour is more elastic:

1. the greater the **elasticity of substitution**: The greater the elasticity of substitution, the closer the isoquant is to a straight line and thus capital and labour are more easily substituted.
2. the greater the **elasticity of demand for the output**: With higher wages, the marginal cost of production increases. This leads to a rise in price and a reduction in demand. The reduction in demand leads to a fall in output and the number of workers will be reduced.
3. the greater the **share of labour in total costs**: The reason for this result is similar to that for the previous one. The more important the share of labour, the greater the impact any change in labour costs will have on marginal cost.
4. the greater the **supply elasticity of other factors of production**, such as capital: So far the implicit assumption has been that there is an infinite amount of capital available at cost *r*. Suppose there is a wage increase and firms wish to substitute capital for labour. If the supply of capital is scarce or inelastic, this adjustment is more difficult to make. Consequently the supply elasticity of other factors of production has an effect on that of labour.

## 2.6. Formalising Marshall's rules

The elasticity of labour with holding output (*Q*) and the rate of return on capital (*r*) constant is a more useful measure of the elasticity of the substitution effect than equation [2-15], since it pinpoints how firms respond to changes in the wage rate.

This is known as the *constant-output labour-demand elasticity* and is calculated as follows (Allen 1938, quoted in Hamermesh 1993: 24):

$$\eta_{LL} = -[1-s]\sigma, \text{ with } \eta_{LL} < 0 \qquad [\,2\text{-}17\,]$$

where $s = wL / Y$, the share of labour in total revenue. $\eta_{LL}$ measures the constant-output labour-demand elasticity. Intuitively, $\eta_{LL}$ is smaller for a given technology $\sigma$ when labour's share is greater.

Similarly, the fourth rule refers to the role of the elasticity of other factors of production (in the two input model, this would be capital). The measure is known as the *cross-elasticity of demand for labour* and can be calculated in a similar way to equation [2-17]:

$$\eta_{LK} = [1-s]\sigma, \text{ with } \eta_{LK} > 0 \qquad [\,2\text{-}18\,]$$

Equations [2-17] and [2-18] can be used to derive an expression for the second Marshall rule, that the elasticity of the demand for output affects the demand for labour. This is the *scale* effect previously discussed. To obtain the two total demand elasticities for labour, these scale effects are added to [2-17] and [2-18].

$$\eta_{LL}' = -[1-s]\sigma - s\eta \qquad [\,2\text{-}17'\,]$$

and

$$\eta_{LK}' = [1-s][\sigma - \eta] \qquad [\,2\text{-}18'\,]$$

Which measure to use when depends on what needs to be determined. Hamermesh (1993: 25) suggests that if the assumptions are that the industry is competitive and can expand or contract with wage changes, then [2-17'] and [2-18'] are better because they capture scale effects. If a typical firm's output is constrained, then [2-17] and [2-18] are the better choices.

## 2.7. Extending the two-factor case

Thus far it has been assumed that there are two inputs into the production process, capital and homogenous labour units. Labour, however, is rarely homogenous and can often be disaggregated by some interesting dimension, such as skill-level, age, race, gender and so forth. This can allow the researcher the opportunity to model how changes in the wage rate of one group of workers affects the demand for another group.

Following Hamermesh (1993: 34), the mathematical theory of demand for several outputs is merely a generalisation of the theory of demand for two factors.

There is, however, the problem of *separability of inputs*. This can be illustrated by considering the following function:

$$Y = F(G(L_1, L_2), L_3) \qquad [\text{2-19}]$$

In [2-19] output is expressed as a function of $G$ and $L_3$. $G$ is in turn a function of $L_1$ and $L_2$. $L_1$ and $L_2$ may be aggregated due to *a priori* reasons, e.g. the researcher considers the two inputs to be more similar to each other than they are to $L_3$. This may, however, lead to incorrect conclusions about the cross-price demand elasticities and the ease of substitution between the two functions.

Hamermesh (*ibid.*) thus suggests the following approach. Consider a firm using $N$ factors of production, $X_1 \ldots X_N$. Let the production function be:

$$Y = f(X_1, \ldots \ldots, X_N), f_i > 0, f_{ii} < 0 \qquad [\text{2-20}]$$

The associated cost function, based on the demands for $X_1 \ldots \ldots X_N$ is:

$$C = g(w_1 \ldots \ldots w_N, Y), g_i > 0 \qquad [\text{2-21}]$$

where $w_i$ are the input prices.

Similar to the two-factor case in [2-7], it can be shown that:

$$f_i - \lambda_1 w_i = 0, \quad i = 1, \ldots \ldots N \qquad [\ 2\text{-}22\ ]$$

and using the cost function:

$$\mathrm{Xi} - \lambda_2 w_i = 0, \quad i = 1, \ldots \ldots N \qquad [\ 2\text{-}23\ ]$$

where $\lambda_1$ and $\lambda_2$ are the Lagrangian multipliers.

The technological parameters can be defined using either the production function in [2-20] or the cost function in [2-21].

This yields the following:

$$\sigma_{ij} = \frac{Cg_{ij}}{g_i g_j} \qquad [\ 2\text{-}24\ ]$$

The own and cross-partial elasticities of factor demand are:

$$\frac{\partial \ln X}{\partial \ln w_i} = \eta_{ij} = \frac{f_j X_j}{Y}.\sigma_{ij} = s_j \sigma_{ij} \qquad [\ 2\text{-}25\ ]$$

It is assumed in [2-25] that the factors are paid their marginal products and $f$ is linearly homogeneous.

## 2.8. The dynamic demand for labour

The discussion so far has focussed on the *static* neoclassical approach. One of the most valid criticisms of the standard neoclassical model is that it ignores possible changes over time. There has thus been a substantial amount of work in recent years on a *dynamic* neoclassical model.

### 2.8. (a) The theoretical model

As noted above, Daniel Hamermesh has become associated with a rigorous neoclassical approach to the demand for labour. In his analysis of dynamic labour demand issues, he concentrates on the role of *adjustment costs.* He suggests – in, for example, Hamermesh (1986, 1992 and 1993) – that one can distinguish the static demand for labour from the dynamic demand for labour by how firms treat the costs of adjusting the amount of labour used in the production process. Adjustment costs play a central role in the firm's *dynamic* decision processes.

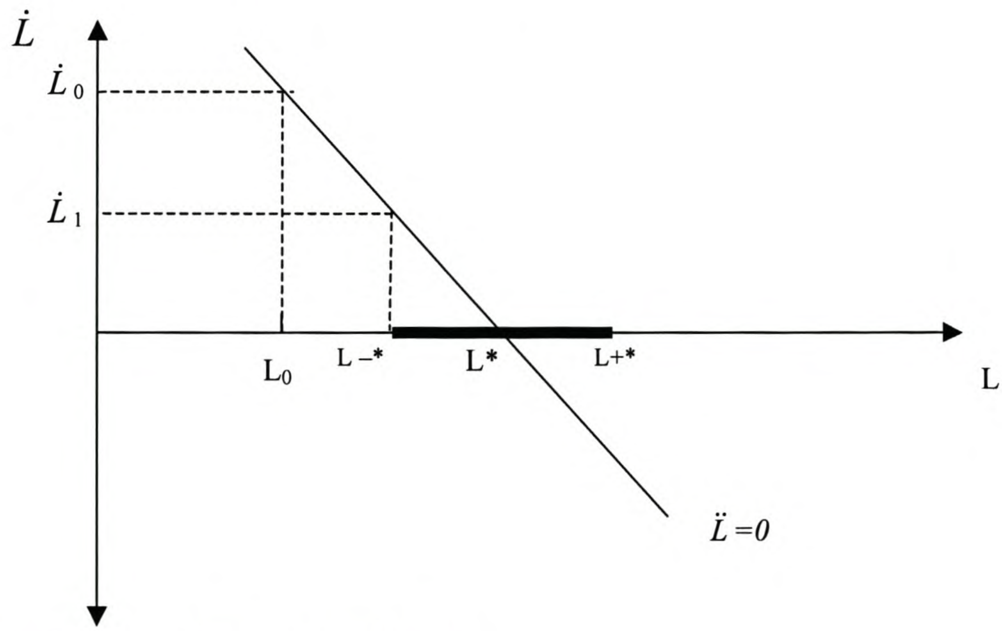
Following earlier work, Hamermesh (1992: 733) presents the firm's equilibrium dynamic demand as follows:

$$C(\dot{L}) = a\,|\,\dot{L}\,| + gL^2 + \begin{cases} k \text{ if } |\,\dot{L}\,| > 0 \\ 0 \text{ if } \dot{L} = 0 \end{cases} \qquad [\,2\text{-}26\,]$$

where the superior dot indicates rate of change. $L$ is employment and $a$, $g$ and $k$ are simply parameters of the adjustment cost function. The parameter $k$ reflects the size of the fixed costs of adjustment; $a$ and $g$ are the size of variable costs.

The motion of $L$ (i.e. the adjustment process) can be shown graphically, as is done in Figure 2-3.

**Figure 2-3**: Dynamics with fixed and variable adjustment costs




*Source: adapted from Hamermesh (1992: Figure 1)*

This allows one to explain the findings intuitively. On the horizontal axis is $L$, the size of the firm's labour force. On the vertical axis is $\dot{L}$, the rate of change in the size of the firm's labour force. The figure thus represents the relationship between the size of a firm's labour force and the change in its size. The line $\ddot{L} = 0$ represents the locus of points where the firm's rate of change in the rate of change of adjustment is constant. In other words, the firm is neither speeding up nor slowing down the process of hiring and firing. There is an equilibrium.

The assumption is that employment has been shocked away from the long-run equilibrium, L*. The heavy line [*L*–*; *L*+*] gives the effect of fixed adjustment costs. Consider the case of a negative shock, large enough to take unemployment below L–* to $L_0$. The firm will adjust the size of its workforce smoothly along the $\ddot{L} = 0$ line. Because $\dot{L}$ is positive, the employer will add workers. Once the number of workers corresponding to *L*–* is reached, however, *L* ceases changing. This is because the fixed costs of changing the size of the labour force exceed the benefits from such a change. In effect, the fixed costs of adjustment that arise within each period create a 'zone of indeterminacy' around *L**.[3]

Higher fixed costs lengthen the heavy line, [*L*–*; *L*+*]. To return to equation [2-26], one can argue that an increase in *g* also lengthens the gap between *L*–* and *L**. An increase in *a* has no effect on the rate of adjustment, but shifts the entire segment leftward. If there are no fixed costs, the standard solution applies. The firm moves back smoothly to its long-run equilibrium at *L**. What would be the solution if there were no variable costs, or if these costs are only linear? In that case the firm would change the number of workers to *L**. The alternative is to leave employment unchanged, if the costs of the change the number of workers exceeds the present value of benefits of having the optimal number of workers.

To represent these conclusions, assume that the firm forecasts the path of future demand shocks rationally as $E_tX_{t+i}$, $i = 0, 1 \ldots$, where *X* describes the demand for labour. It is a vector of forcing variables in a behavioural relation. If the firm is not on the ray [*L*–*; *L*+*], we can describe observed employment as:

$$L_t = \gamma L_{t-1} + [1-\gamma]E_t \sum_{i=0}^{i=\infty} X_{t+i}[1+r]^{-i} + \mu_{1t}$$

$$\left| L_{t-1} - E_t \sum_{i=0}^{i=\infty} X_{t+i}[1+r]^{-i} \right| > K \qquad [\,2\text{-}27\,]$$

Hamermesh makes the assumptions that $1 > \gamma \geq 0$ and $\mu_{1t}$ is a disturbance with mean zero and variance $\sigma^2$. Relating the two equations, it can be shown that $\gamma$ in [2-26] is correlated with the size of the quadratic term in [2-27]. If $\gamma = 0$, then $K$ measures the fixed costs of adjustment costs. When $\gamma$ is non-zero, then $K$ can be interpreted as reflecting the length of the ray [$L-*$; $L+*$]. $K$ is effectively a measure of the fixed costs of adjustment.

If the vector $X$ contains $M$ forcing variables:

$$E_t \sum_{i=0}^{i=\infty} X_{t+i}[1+r]^{-i} = \sum_{m=1}^{m=M} \left\{ \sum_{m=1}^{j=N} \alpha_j X_{t-j} + \varepsilon_{mt} \right\} \qquad [\,2\text{-}28\,]$$

where the $\alpha$ and $\varepsilon$ are respectively vectors of parameters and i.i.d. disturbances. The error term is assumed to be distributed normally with mean zero and variance $\sigma^2$. It is thus possible to reformulate [2-28] as:

$$L_t = \gamma L_{t-1} + [1-\gamma] \left\{ \sum_{m=1}^{m=M} \sum_{j=1}^{j=N} \alpha_j X_{t-j} + \varepsilon_t \right\} + \mu_{1t}$$

$$\left| L_{t-1} - \left\{ \sum_{m=1}^{m=M} \sum_{j=1}^{j=N} \alpha_j X_{t-j} + \varepsilon_t \right\} \right| > K \qquad [\,2\text{-}28'\,]$$

The firm implicitly assesses the previous period's value of employment and the available information on the demand for labour at the start of the period, then decides whether to alter the number of people employed.

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[3] The alternative situation could also have been analysed, where employment receives a positive shock.

Ignoring the switching condition that determines whether or not the firm changes employment, [2-28] is the standard geometric lagged adjustment mechanism.

Thus in Hamermesh's general model adjustment stops some distance before the moving optimal level of employment (the firm's target) because of the presence of fixed adjustment costs.

This is the third and final theme from this chapter: **adjustment and adjustment costs matter.**

### 2.8. (b) Empirical results

Hamermesh (1992: 735) uses two firm-level data sets to test the assumptions of his approach. The first is a data set on the employment of mechanics in seven airlines. He includes wages in the vector $X$ (which measures the demand for labour). The proxy for output is departure revenues. Both output and wages are lagged, since the model assumes that employers base expectations on past values. The second is a data set using information on heavy manufacturing industries. In this case the output data is richer, allowing for more careful modelling of employers' expectations.

For the airline industry data set, his results indicate that the generalised model presented above does hold. He estimates a sample $K$ value of 0,045. This would indicate that if the firm is within 4,5 per cent of its profit maximising level of employment, small shocks will not induce the firm to change the size of its workforce. The manufacturing data set yields similar results. The sample $K$ estimate is 0,0546. This implies that this firm holds production-worker employment constant unless demand shocks are sufficiently large (in this case greater than 5,46 per cent). If the shocks are large enough, the firms will move discretely to the expected profit-maximising level of employment $L^*$.

### 2.8. (c) Application

The results highlight two issues. Firstly, fixed adjustment costs are important when the firm makes decisions regarding whether or not to change the size of its workforce in response to dynamic shocks. Secondly, firms may not always be operating at their profit-maximising (equilibrium) level of employment.

Hamermesh suggests that employment may not move towards the optimal level of employment because of the presence of adjustment costs. The firm may rationally decide to stop changing the size of its labour force, simply because the benefits of such a change outweigh the costs of the change.

## 2.9. Conclusion

This chapter discussed the demand for labour within a neoclassical framework. Three themes were identified:

i. The demand for labour is a derived demand – if there is no demand for goods and services there will be no demand for labour.

ii. Relative prices matter – if labour is relatively expensive, then firms will prefer capital-intensive production.

iii. Adjustment matters – firms may not operate at their optimal rate of employment because of high adjustment costs.

The neoclassical approach detailed above has both advantages and disadvantages. For all its mathematical rigour and theoretical appeal, there is, however, one particular disadvantage. It does not explain high levels of unemployment. One of the assumptions of the traditional neoclassical model was relaxed, *viz*. that the solution is static. It was found that by introducing dynamic effects into the neoclassical model, the optimal level of employment may not be reached because of the presence of adjustment costs. This, however, can only explain a small portion of unemployment. The underlying argument remains unshaken: the labour market should clear in the Walrasian tradition and all factors of production should be allocated efficiently.

The next chapter considers why the labour market may not clear by specifically considering the theoretical literature on labour market distortions and rigidities.

# Chapter 3: Beyond the Neoclassical Approach

*Too large a proportion of recent 'mathematical' economics are mere concoctions, as imprecise as the initial assumptions they rest on, which allow the author to lose sight of the complexities and interdependencies of the real world in a maze of pretentious and unhelpful symbols*

*JM Keynes (1936), on neoclassical economics*

## 3.1. Introduction

The neoclassical interpretation dominated explanations of how the labour market functioned until the early twentieth century. The experience of the Great Depression, however, ushered in a period where the neoclassical arguments were questioned and in many instances discarded. This chapter sets out to discuss some of this literature and how it relates to the broader theme of the demand for labour. The overall conclusion of the chapter is that neoclassical explanations do indeed provide a useful starting point for any rigorous analysis of the labour market, but that more structural arguments can complement the neoclassical approach.

## 3.2. Disequilibria and the Keynesian approach

The work of John Maynard Keynes is most closely associated with the revision of much of the neoclassical approach to labour market issues as the quote above highlights.

Keynes (1936: 5) suggests that the classical approach to the determination of employment and wages is based on two 'fundamental postulates'. These are:

I. The wage is equal to the marginal product of labour

II. The utility of the wage when a given volume of labour is employed is equal to the marginal disutility of that amount of employment.

The first postulate has been discussed at length in the previous chapter. The second postulate suggests that workers will be paid as much as is needed to induce them to work[4]. Modern economic terminology refers to this wage as the reservation wage (see, for example, Kingdon and Knight 1999). The classical position is that the demand for labour is given by the marginal product of labour ($MP_L$). The amount of labour employed is simply where the reservation wage equals the $MP_L$.

Keynes then puts forward two objections to the second postulate. Firstly, when the price level rises and nominal wages stay constant, real wages fall. The second postulate suggests that the supply of labour will fall. He argues this is not supported by observation. Secondly, his more 'fundamental' objection relates to wage determination.

Azam (1994) has usefully reduced the difference between the classical and Keynesian approaches to a series of mathematical relationships set out below.

The 'first postulate of the classics' that Keynes speaks of can be written in log-linear form as:

$$l^d = a - b\,(w - p) \qquad [\,3\text{-}1\,]$$

where $l^d$ is labour demand, $w$ and $p$ are the nominal wage and price of output and $a$ and $b$ are positive constants. Given [3-1], the 'classical' assumption is that the wage rate adjusts quickly to maintain the relationship between demand and supply:

$$l^d = l^s \qquad [\,3\text{-}2\,]$$

where $l^s$ is the supply of labour, which is regarded as exogenous in this model. In this case, nominal shocks, captured as changes in $p$, have no real effects, but are passed on as changes in $w$. The equilibrium real wage is thus:

$$w - p = (a - l^s)/b \qquad [\,3\text{-}3\,]$$

[4] Or as Keynes (1936) puts it, "the real wage of an employed person is that which is just sufficient (in the estimation of the employed persons themselves) to induce the volume of labour employed to be forthcoming."

As the previous chapter highlighted, the neoclassical approach proposes that the wage rate is a result of market processes. The Keynesian approach reverses this causal chain, from the supply of labour to the equilibrium wage rate and assumes that the equilibrium wage rate is given exogenously as follows:

$$w = w^{k} \qquad [\,3\text{-}4\,]$$

where $w^k$ is a constant.

One then gets an 'unemployment equilibrium', with the level of employment (and hence of output) given by:

$$l^d = a + b.p - b.w^k \qquad [\,3\text{-}5\,]$$

Nominal shocks have real effects, as any change in $p$ affects $l^d$. Azam (1994: 65) suggests that the assumption given by [3-4] is 'somewhat crude'. During periods of inflation, wages and prices chase each other. It would be more credible to replace [3-4], as Keynes did later, with a wage-setting rule based on expectations:

$$w - p^e = c \qquad [\,3\text{-}6\,]$$

where $c$ is a constant and $p^e$ is the price level expected by the workers to prevail during the period for which $w$ has been decided. In effect, the wage rate is thus determined in advance, with a view to maintain a given purchasing power. In this form, the nominal rigidity implied by [3-4] above is in fact explained by a real rigidity. This real rigidity is the fact that workers pursue a purchasing power target.

Substituting [3-6] into [3-1], one gets:

$$l^d = l^s + b(p - p^e) \qquad [\,3\text{-}7\,]$$

This is a rather important result. It says that the inflation only has a real effect on the demand for labour if it is unexpected. Similarly, Azam (1994: 66) compares this with

Phillips' (1958) empirical result, which can be written for the sake of simplicity as the following wage-setting rule:

$$w = c - g(l^s - d) \qquad [\,3\text{-}8\,]$$

where $(l^s - l^d)$ is the difference between the supply of labour and the demand for labour, i.e. the unemployment rate. Equation [3-8] can be regarded as a compromise between the Keynesian view and the classical approach, with the nominal wage moving slowly in response to excess demand. The Phillips curve makes nominal shocks particularly powerful. This can be shown by substituting [3-8] into [3-1], which yields:

$$l^d = x + zp \qquad [\,3\text{-}9\,]$$

where $x$ and $z$ are constants.

The Phillips curve was subject to criticism: it implies that workers suffer from money illusion, determining the wage rate without taking into account its purchasing power, as influenced by $p$. Azam (1994: 67) quotes the work of Friedman (1968) and Phelps (1968) which reconciles the Phillips curve with the work of Keynes[5]. The wage-setting equation is:

$$w - p^e = c - g(l^s - d) \qquad [\,3\text{-}10\,]$$

Wages, deflated by expected prices, are a function of a constant and unemployment. The relation in [3-10] has become known as the 'expectations-augmented Phillips curve'. The policy conclusions that can be drawn by the changing this assumption is similar to that provided above:

$$l^d = x + z(p - p^e) \qquad [\,3\text{-}11\,]$$

[5] A longer discussion of the Phillips curve is given in the following chapter.

In a nutshell: the demand for labour is a function of some constant $x$ and unexpected shocks, which feed through because $p^e$ , the expected price, does not equal $p$, the actual price.

By carefully comparing [3-5] and [3-11], one can see quite an important result. Equation [3-5] suggests that the omniscient and omnipotent policymaker can expand the demand for labour by subjecting the economy to inflationary shocks. Equation [3-11] introduces the idea that this can only be the case if actual inflation exceeds expected inflation. A policy of unanticipated shocks, however, is subject to time inconsistency problems (see, for example, Whitley 1994: 212). Time inconsistency occurs when policies that are initially optimal fail over time because rational agents change their inflationary expectations and begin believing that policy makers will subject the economy to periodic inflationary shocks.

## 3.3. Wage contracts

The neoclassical approach treats the labour market in a similar way to the goods market. It is implicitly assumed that employers and workers continually negotiate the market-clearing wage. Clearly this is not a valid assumption. Most employers and workers enter into wage contracts. One simple type of contract specifies a wage, and the firm can choose the level of employment consistent with the desired level of output (Romer 1994: 463). Under an arrangement such as this, real wage rigidity arises immediately and leads to unemployment as the labour market cannot clear instantaneously.

If the demand for labour were to fall, the burden of adjustment falls onto the quantity of labour and not onto the cost of labour. Wages are sticky downwards and this creates unemployment.

The introduction of wage contracts into a neoclassical model may seem to solve the problem of explaining unemployment. Unfortunately, there is a rather important flaw. Being subject to a wage contract renders both the employer and the employee more vulnerable to sudden changes in the demand for labour. Should the demand for labour inexplicably rise, the employee cannot reap the benefits of a higher wage. Should the demand for labour, on the other hand, inexplicably fall, the employee is vulnerable to becoming unemployed. There therefore needs to be an explanation why employers and employees would enter into a wage contract, because in the absence of an incentive for either party, it is doubtful that wage contracts would exist.

Two possibilities have been proposed: in a developing country context, the efficiency wage hypothesis and in a developed country context the insider-outsider theory. Both are considered in turn below.

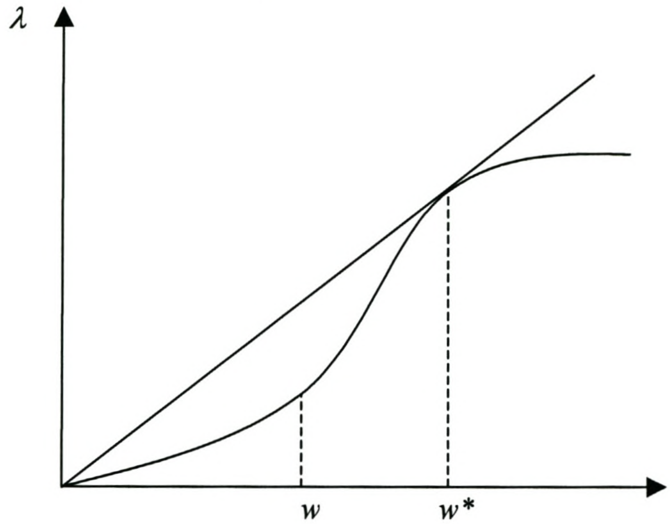
## 3.4. The efficiency wage hypothesis

Following the work of Keynes, the stickiness of wages became a key focus of much of the literature on labour markets during the 1950s. At the same time there was an increasing interest in the economics of developing nations, with many theorists putting forward models of why lesser developed countries developed differently to advanced economies (for a review see Bernstein 1973). One theory that gained prominence was the efficiency wage hypothesis. The seminal paper is generally regarded to be that of Leibenstein (1957). The idea has a prominent place in the labour market literature, with excellent reviews given by Katz (1986) and Akerlof and Yellen (1986). The version that will be presented here is that of Stiglitz (1976), who developed the model whilst working as a researcher at the University of Nairobi.

### 3.4. (a) Background to the analysis

As background to the analysis, Stiglitz (1976: 187) hypothesises that the services a labourer renders are a function of the wage he receives, that is '[o]ne well-paid worker may do what two poorly paid workers can do'. If $\lambda(w)$ is an index of the efficiency of a worker who receives wage $w$, then one can hypothesise that $\lambda$ has a shape similar to that given below, in Figure 3-1. As the figure shows, initially there are increases in efficiency from raising wages, but over time diminishing returns set in.

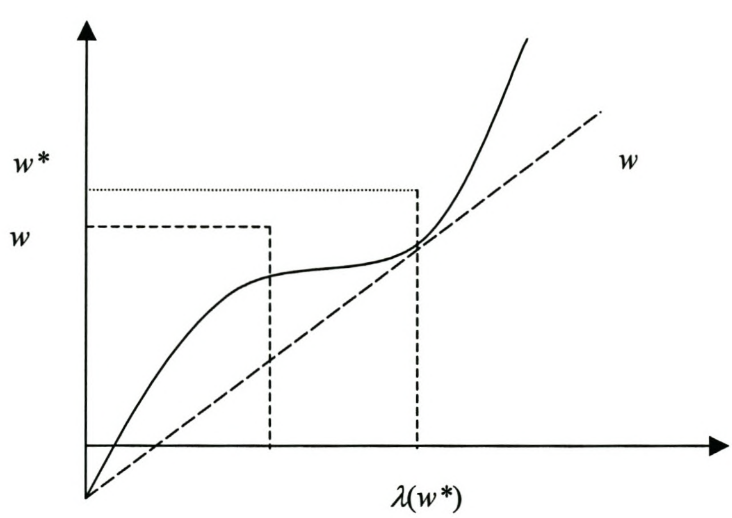
**Figure 3-1**: The hypothesised efficiency curve




*Source: Stiglitz (1976: Fig 1)*

This curve can be transformed into a 'wage requirements' curve by reversing the axes, as is shown in Figure 3-2.

**Figure 3-2**: The wage-requirements curve




*Source: Stiglitz (1976: Fig 2)*

One can then consider the production function as given by the following:

$$Q = G(E) \qquad [\,3\text{-}12\,]$$

where $Q$ is output and $G$ represents the production process as a function of $E$, the total number of efficiency units supplied by workers. The assumptions of positive marginal product and diminishing returns to labour mean that $G' \geq 0$ and $G'' \leq 0$.

### 3.4. (b) Alternative objectives for the firm

Section 2.3 discussed three neoclassical objectives of the firm: the profit-maximising firm, the output-maximising firm and the cost-minimising firm. These are essentially the same 'polar' cases discussed by Stiglitz (1976). To this list, however, he adds two additional types of firms which may be more representative of the average firm (or as he terms them, farms) in developing nations[6]. These are:

- The egalitarian family farm, in which income is divided equally amongst its members; and
- The utilitarian family farm, which maximises family social welfare.

He notes that there is a curve depicting the minimum wage that can be paid, based on the minimum food requirements for obtaining a given number of efficiency units.

One can thus view the Stiglitz model as an extension of the neoclassical model of the firm, not as a competing paradigm. As the 'usual' types of firms have been set out in some detail above, the discussion below considers the egalitarian and utilitarian farms.

### 3.4. (c) Egalitarian farm

The egalitarian farm divides total output equally amongst its members / workers (Stiglitz 1976: 191). Following his notation, thus:

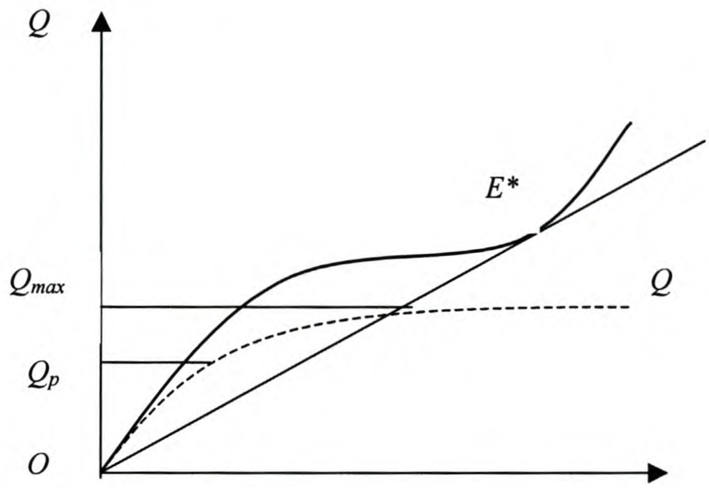
$$w_e = \frac{G(\lambda(w_e)\bar{L})}{\bar{L}} \qquad [3\text{-}13]$$

The wage that will be paid will simply be where the minimum food requirement intersects the curve described in [3-13] above.

[6] Even in developed countries, family-owned and managed firms account for a substantial portion of businesses. There is an emerging literature on the particular complexities of this model of industrial organisation.

Once again, we turn to a graphical analysis. Stiglitz (1976: 189) represents [3-12] above as a production function of decreasing returns to scale. In Figure 3-3 on the following page, this is represented by the dashed line *OQ*. The wage requirements curve of Figure 3-2 is represented by the solid line *OE*.

**Figure 3-3**: Efficiency wages in the very poor economy




*Source: Stiglitz (1974: Fig 4d)*

In the figure $Q_{max}$ refers to the maximum output at a wage rate of $w_{max}$.

As can be seen, in the very poor economy, the wage requirements curve is above the output curve at all points. Paying the same wage to all workers is simply not possible. The straight line *OE*, however, does intersect the output curve, although at a point where there is inequality distribution of wages. Thus with some inequality, the economy is viable.

It can be shown for other types of economies that different results hold. In a very rich economy, for example, the opposite situation to that in Figure 3-3 is true: the wage requirements curve is *below* the output curve. Overall, the Stiglitz version of the efficiency wage hypothesis suggests that there are sound reasons why in developing countries wages may exceed the market-clearing rate leading to inequality and unemployment.

## 3.5. Insider-outsider models

### 3.5. (a) Overview

The insider-outsider theory examines the behaviour of economic agents in markets where some participants have more privileged positions than others. The seminal work on this theory is a series of papers by Lindbeck and Snower (1988, 1990 and 2001, amongst others).

The Lindbeck-Snower model suggests that current workers ('insiders') often enjoy more favourable opportunities than the 'outsiders'. The two groups of workers come about because firms incur labour turnover costs when they replace insiders with outsiders. These turnover costs may be the costs of hiring, firing or providing firm-specific training.

The insider-outsider model rests on four central assumptions (Lindbeck and Snower 2001: 166):

- Firms face labour turnover costs that they cannot entirely pass on to their employees;
- Insiders have some market power;
- With time, new entrants can become 'insiders'; and
- Employment decisions are made unilaterally by the firms.

### 3.5. (b) Turnover costs

Labour turnover costs are central to the insider-outsider approach. There are two types of turnover costs in this model: 'production-related' and 'rent-related'.

'Production-related' turnover costs are costs incurred in making the employee more productive (Lindbeck and Snower 2001: 167). These may include costs such as search, hiring and relocation costs. 'Rent-related' turnover costs are instead the outcome of insiders' rent-seeking activities. These may include severance pay, seniority rules, advance notice of dismissal and legal protection against firing. If insiders also have political influence, they may use the political process to raise rent-related turnover costs.

### 3.5. (c) Extreme version

In the extreme version of the model, the firm's profits can be expressed as follows (Romer 1994: 466):

$$\pi = AF(L_I + L_O) - w_I L_I - w_O L_O \qquad [3\text{-}14]$$

where $\pi$ is the profit the firm makes. $A$ is a stochastic efficiency variable that varies from firm to firm. Output is calculated as the output per worker $AF$ multiplied by the number of insiders $L_I$ plus the number of outsiders $L_O$. The wage is set through negotiations between the employers and the insiders. The insiders also have priority in hiring; thus $L_O$ can only be positive if the number of insiders that are hired equals the number of insiders that are available to be hired, $\overline{L}$. The extreme version of the model suggests that, because of normal employment growth and turnover, most of the time the insiders are fully hired. The only hiring decision that the firm needs to make is how many outsiders to hire. As the insiders are always employed, their utility only depends on their wage. As a result, they are not exposed to the risk of being unemployed due to non-market clearing wages.

This situation leads to the average wage being counter-cyclical and not pro-cyclical. This is because the wage of insiders does not change over the business cycle. During economic upswings, the firm can hire additional workers (outsiders) at a rate far less than that paid to the insiders. The average wage paid thus falls. During economic downswings, however, the firm lays off its cheap workers and retains the expensive insiders. This pushes the average wage up.

As Romer (1994: 468) notes, if the entire labour market is characterised by insider power, this reduces employment by raising the wage and causing firms to move up their labour demand curves. A more realistic case is for there to be insider power only in part of the market, with the rest perfectly competitive. This may indeed still create unemployment – those sectors that are characterised by insider power are sought-after and workers are prepared to wait longer for positions within them. Frictional employment is thus higher.

### 3.5. (d) Critique of the insider-outsider approach

Fehr (1990) and Fehr and Kirchsteiger (1994) criticise the insider-outsider approach. The critique is that under the standard assumptions of powerful and selfish insiders bargaining collectively over wages, both the firm and the incumbents are strictly better off when they implement a market-clearing two-tier system. Lindbeck and Snower (2001: 166), however, argue that a two-tier system does not often get implemented, because there is an absence of 'underbidding[7]'. This may be for three reasons. Firstly, the insiders may be so strong as to make it impossible for underbidding to occur. Secondly, legislation may prevent underbidding (e.g. minimum wage legislation) and finally, firms may be paying efficiency wages.

### 3.5. (e) Alternative insider-outsider model

An alternative insider-outsider model is that of Blanchard and Summers (1989). They argue that in the presence of diminishing returns to labour, the larger the workforce the lower the wage (under the condition that the wage equals the marginal physical product of labour). By ensuring that the workforce is not expanded by letting in outsiders, insiders ensure that wages remain high.

## 3.6. Search-and-matching models

### 3.6. (a) Overview

The search-and-matching model has become a popular approach to explaining frictional unemployment. It was a natural development of the 1961 Stigler model of individual behaviour (Pissarides 2000). This approach suggests that the individual will choose the optimal number of sellers to search before buying at the lowest price. During the seventies, Phelps, amongst others, applied the Stigler model to analyse the natural rate of unemployment and the inflation-unemployment trade-off. The model is now most closely associated with DT Mortensen and Christopher Pissarides. In a series of articles and reviews, these two economists have developed the search-and-matching model to the present version (see, for example, Mortensen 1982, Pissarides 1985 and Mortensen and Pissarides 1999). For a 'non-parametric' approach to the question see Wittenberg (2001).

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[7] That is where outsiders in the second-tier offer their services for lower wages than those in the insiders' first-tier.

### 3.6. (b) Recent developments

A common version of the formal search-and-matching model is discussed in Pissarides (2000).

An individual has one unit of labour to sell to firms, which create jobs. The valuation of the labour takes place under the assumptions that agents have infinite horizons and discount future income flows at a constant rate $r$. Implicitly they know the future path of prices and wages and they maximise the present discounted value of expected incomes. Suppose that $U_t$ is the expected discounted value of a unit of labour before trade at time $t$ (that is the "value" of an unemployed worker) and $W_t$ is the discounted value of an employed worker, then during a short time interval $\delta t$, the unemployed worker receives income $b\delta t$, and a job offer arrives with probability $a\delta t$. The frictions studied in the economics of search are summarised in the arrival process. In the absence of frictions, $a \to \infty$; with frictions and search, $a > 0$; with no search a = 0.

Now consider the case of a job offer arriving. The individual has got the choice of either accepting or rejecting the job offer. There are thus two alternative expected outcomes (Pissarides 2000: 3). If the individual accepts the job offer, then his expected return is $W_{t+\delta t}$. Alternatively, the individual does not need to accept the job offer. In this case, the individual's expected return is $U_{t+\delta t}$ . The return for the individual is also $U_{t+\delta t}$ if no job-offer arrives.

With a discount rate of r, $U_t$ satisfies the Bellman equation:

$$U_t = b\delta t + a\delta t \frac{\max(W_{t+\delta t}, U_{t+\delta t})}{1 + r\delta t} + (1 - a\delta t)\frac{U_{t+\delta t}}{1 + r\delta t} \qquad [\,3\text{-}15\,]$$

Re-arrangement of terms yields

$$rU_t = b + a(\max(W_{t+\delta t}, U_{t+\delta t}) - U_{t+\delta t}) + \frac{U_{t+\delta t} - U_t}{\delta t} \qquad [\,3\text{-}16\,]$$

Taking the limit as $\delta t \to \infty$, and omitting the sub-scripts for convenience, yields what Pissarides (2000: 3) describes as the 'fundamental equation in the economics of search':

$$rU = b + a(\max(W, U) - U) + \dot{U} \qquad [3\text{-}17]$$

To re-cap the symbols used: $r$ is the discount rate, $U$ is the discounted flow of future income, given that the individual is unemployed, $b$ is the individual's income from unemployment benefits, $a$ is the unweighted probability of a job offer arriving and $W$ is the discounted flow of future income, given that the individual is employed. The final term, $\dot{U}$, is the rate of change in $U$.

Although the equation as it stands above is applied to the labour market, it is equally applicable to the theory of arbitrage[8]. Indeed, as Yashiv (2000: 1297) points out, search-and-matching models are the solution to an inter-temporal investment problem under uncertainty. A search-and-matching approach can thus explain much of the behaviour in markets other than that of labour. As such, the approach may go a long way toward explaining a number of macroeconomic fluctuations.

For most labour-market analysis, however, the final $\dot{U}$ term falls away. According to Pissarides (2000), this is because the majority of the literature concentrates on 'steady states', i.e. situations where the discount rate, transition rates and income flows are all constant. With infinite horizons there are then stationary solutions to the valuation of equations, obtained from the 'fundamental equation' when $\dot{U} = 0$

A simple solution to equation [3-15] is offered by assuming that employment is an 'absorbing state', so when a job that offers wage $w$ is accepted, it is kept for life. Then, $W = w/r$. If the individual is sampling from a known wage-offer distribution $F(w)$, then the stationary version of [3-15] satisfies

[8] In that case it could be given as the interpretation of an arbitrage equation for the valuation of an asset in a perfect capital market with a risk-free interest rate $r$ (Pissarides 2000: 3). This asset yields coupon payment $b$ at some rate $a$. The asset also gives its holder the option of a discrete change in its valuation,

$$rU = b + a \qquad [\,3\text{-}18\,]$$

The option to accept a job offer is taken if $w / r > U$, giving the reservation wage equation:

$$\xi = rU \qquad [\,3\text{-}19\,]$$

The reservation wage is defined as the minimum acceptable wage. The implication is that an individual will only accept a job when the wage rate on offer is higher than the amount of money he or she earns unemployed multiplied by the individual's discount rate[9].

### 3.6. (c) Critique of the search-and-matching model

The search-and-matching approach to explaining equilibrium unemployment has been criticised by Shirmer (2003). He suggests that a broad class of search models are not capable of generating the observed business-cycle-frequency fluctuations. Under even the weak assumptions of a standard search-and-matching model (such as the Pissarides one above), search models predict that the vacancy-unemployment ratio and labour productivity should have the same variance. In practice, however, the vacancy-unemployment ratio is twenty times as volatile as labour productivity.

He suggests that the fault does not lie with the search-and-matching model *per se*, but rather with the assumption that wages are determined using a Nash bargaining framework. He reconciles his empirical findings with the theoretical model by introducing a wage-determination framework where wage determination leads to far more rigid wages.

---

from $U$ to $W$. Optimality requires that the option is taken (and the existing valuation taken up) if $W \geq U$. The last term $\dot{U}$ shows the capital gains or losses due to changes in valuation of the asset.

[9] The model does not take explicitly take into account the costs of employment, such as transportation costs to the workplace. However, it is assumed that these are implicit in $W$.

## 3.7. Conclusion

The chapter reviewed some of the theories explaining the existence of unemployment. In the standard neoclassical framework, only wages, output and adjustment costs are of concern to the firm in the employment decision. Under neoclassical conditions, wages will always adjust to ensure that the labour market will 'clear'. Persistent unemployment is an empirical fact, however, that needs to be explained.

First the Keynesian disequilibrium approach was considered, where disequilbria in the labour market (and other markets) may persist and may even require state intervention to be 'fixed'. This theme was then developed by considering the existence of wage contracts. This may lead to rigidity within the labour market, which may lead to unemployment. There may also be incentives for firms in developing countries to pay certain workers more, leading to 'efficiency wages'. Then the role of powerful insiders was discussed. Insider-outsider models attempt to explain the employment and wage outcome in the presence of strong union movements. Next, the search-and-matching model was discussed. In essence this model provides a rigorous framework within which to consider frictional unemployment. It suggests that unemployment exists because firms and workers take time to 'find each other'.

No single theoretical model can explain persistent unemployment. Each, however, does provide some insight into how the labour market functions. The chapter developed in a more rigorous way the arguments that characterise the South African labour market debate.

The important outcome of the discussion is that in the presence of market imperfections and structural problems, the cost of labour increases. This in turn leads to a fall in the quantity demanded of labour, with the result that the labour demand and supply cannot equilibrate. This in turn leads to unemployment.

The analysis so far has been on a theoretical level. The following chapter considers the South African application of the neoclassical and Keynesian/structuralist approaches to labour market analysis.

# Chapter 4: The Policy Debate

*Hier in Suid-Afrika word die meerderheid van opgeleide ekonome meestal sakemanne wat uiteindelik méér op die vlak van die mikro- of bedryfsekonomie funksioneer. Hulle verkry ná hul formele opleiding 'n belangstelling in 'n spesifieke organisasie of bedryfsrigting, of enkele sektor van die ekonomie. In dié proses verloor hulle die objektiwiteit van die makro-ekonoom en word hul menings oor die totale ekonomiese bedrywigheid en oor makro-ekonomiese beleid deur gevestigde belange beïnvloed.*

Dr Chris Stals (1997)

*The workmen desire to get as much, the masters to give as little as possible,*

Adam Smith, 1776 (2000: 75)

## 4.1. Introduction

Up to this point, the microeconomic analysis has been at the theoretical level. This chapter attempts to present the policy debate in terms of the labour market theories above. Given this objective, the analysis in many ways oversimplifies a number of issues. Also, there has been a significant shift towards seeking common ground. Nevertheless, as the quote from Stals (1997) above highlights, often policy proposals are coloured by the ideological biases and entrenched self-interest of the individuals that engage in the debate. No economist can ever be truly objective. However, at least attempting to understand the difference in opinion (and the possible root cause) gives the researcher a more balanced point from which to start analysing the dynamics of the labour market.

This chapter splits the protagonists into two simplified groups: the 'interventionists' and the 'non-interventionists'. These groups are closely related to interest groups: for example the South African Foundation is a research think-tank funded by business organisations and NALEDI is the economic research and policy arm of the Congress of South African Trade Unions, COSATU.

## 4.2. The role of the state

The putative fault line between the two ideological groupings is the role of the state in the South African economy. The need for the state to play a role in post-apartheid South Africa is not, however, much of a contentious issue. This need was clearly expressed as early as 1993, as encompassing the following (Fourie, Donaldson, Siebrits and Obermeyer 1993: 22):

- Promotion of a social and economic environment conducive to growth and diversification of private enterprise;
- Efficient and equitable provision of public goods and services;
- Financing of public expenditure through efficient and equitable taxation and the responsible use of other financing; and
- Maintenance of macroeconomic stability.

Against this background, the role of the state in playing a key developmental role is also acknowledged, insofar as the state's playing a role in developing institutions, poverty alleviation, capacity building and the empowerment of the poor (Fourie *et al* 1993: 3). This envisaged role of the state was broadly implemented in the government's macroeconomic strategy document (Department of Finance 1996) and subsequent annual medium-term expenditure frameworks from the Department of Finance and its successor, the National Treasury.

The point of departure of this thesis is that the objectives of the state have largely been determined[10]. There is, however, still room to discuss issues around the debate on how active the state should be to achieve redistribution.

The debate can also be read within the context of the international theoretical literature on labour institutions. There is a relationship between political objectives and lobbyists aiming to influence the apparatus of the state to achieve political ends. Weil (2003: 45), for example, points to the work of Stigler. Stigler's argument is that the significant influence of small interest groups arises from their ability to surmount the free rider problem amongst supporters. This is as a result of the potentially high return in the form of wages and increased worker rights from political action and the ability of members of the coalition to sanction non-participants (e.g. through

[10] As has been noted by Du Plessis (2003: 59), the South African constitution has also been interpreted as embodying a broadly market-based economy with the state expected to play a redistributive role. In addition, a series of decisions in the Constitutional Court have emphasised the state's responsibilities in terms of adequate housing, medical care and safety and security.

intimidation). Given the institutional characteristics of the South African labour market, any researcher must at least pause to consider the institutional groupings.

### 4.2. (a) The Non-Interventionist grouping

The pro-business grouping is more comfortable with a non-interventionist view of a self-regulating economy that distributes resources efficiently and effectively through the market mechanism, broadly in line with the neoclassical model as set out in chapter 2.

Barker (1999), for example, wants to roll back the involvement of the government in the labour market (e.g. regulations and so forth). More broadly, Du Plessis (2003) proposes rule-based monetary policy to reduce the possible distortionary influences of government or agencies of the government in the management of money.

### 4.2. (b) The Interventionist grouping

For the purposes of this analysis, the Interventionist group will be taken to mean those closely connected to the South African labour movement. They can also connected to the labour constituency in NEDLAC, a discussion forum where formal business, organised labour and community organisations are given an opportunity to discuss policy with senior representatives from the policy-making branches of the civil service.

As Adelzadeh (1996) points out, the Interventionist pro-labour grouping traces their ideological perspective to the economic ideas of Ricardo, Malthus, Marx, Keynes and Kalecki. In his summary of the groupings arguments, growth is believed to be related to income and income distribution, which argues for active government participation in the economy. The argument is that government should encourage the economy to long-run equilibrium and full employment of factors of production. This is broadly the Keynesian/Structuralist argument discussed in chapter 3, although coloured by specific union objectives, such as real wage growth. Given the important role that unions play, they will form the focus of the following sub-section.

## 4.3. The role of unions

### 4.3. (a) Unions and wage determination

The South Africa Foundation, a business think-tank in the non-inteventionist tradition, asserted in an early policy document (South Africa Foundation 1996) that unions significantly increase the costs of labour and thus increase wage costs carried by businesses. This leads to the reduction in the demand for labour.

Empirical evidence in Rospabé (2001) supports the view that unionised workers are paid better than their non-union counterparts, as is shown in Table 4-1.

**Table 4-1:** Average hourly net earnings by race and population status

| | **Black workers** | **White workers** | **Ratio of white to black earnings** |
|---|---|---|---|
| Unionised | 11.6 | 25 | 2.24 |
| Non-unionised | 6.2 | 27.4 | 4.4 |
| Both | 8.2 | 26.7 | 3.3 |
| Ratio of unionised to non-unionised | 1.8 | 0.9 | |

*Source: Rospabé (2001)*

The Non-Interventionist argument is that there is an urban 'labour aristocracy' (discussed in Adler and O'Sullivan 1996). These workers earn more than they are worth. Using their unionised power they ensure that wages remain artificially high. This relates back to the 'insider-outsider' analysis of section 3.5. The insiders have access to jobs that pay more than the market-clearing rate, whilst the outsiders remain in either sub-standard jobs or are unemployed.

The counter argument (e.g. Adler and O'Sullivan1996) is that the objective of unions should be to remove the apartheid-era wage differentials between races. Thus the objective should not necessarily be *within race* wage equality, but rather *between race* wage equality. Adler and O'Sullivan (1996: 174) do find wage differentials between unionised and non-unionised workers, although they suggest that these differentials are a function of the fact that unionised workers are on average better educated than their non-union counterparts. They also find that the differential is not statistically significant[11]. Their findings are reported in Table 4-2.

**Table 4-2:** Average monthly income by race and education

| | **Primary education or less** | | | **Secondary education** | | |
|---|---|---|---|---|---|---|
| | *All* | *Black* | *White* | *All* | *Black* | *White* |
| Union members | 551 | 541 | 2 733 | 1 714 | 1 305 | 2 650 |
| Non-members | 476 | 472 | 1 838 | 1 245 | 818 | 2 713 |

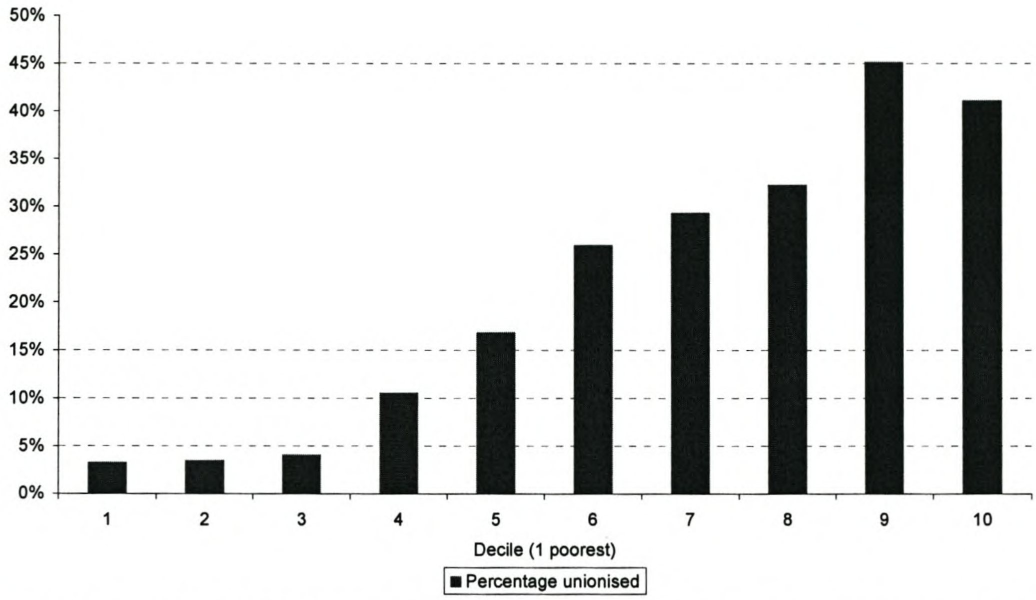
*Source: Adler and O'Sullivan (1996, Table 3)*

Research on this matter by Fallon and Lucas (1998) and Rospabé (2001) does find that even after normalising for other characteristics (e.g. education, occupation, skill level, location and race), union members can still expect to be paid a statistically significant wage premium of up to 20%. This would suggest that one of the determinants of wages is union membership.

Van der Berg (2003) shows also that 61,8 per cent of trade union members are in the top two income deciles. This indicates that trade union members are relatively wealthy compared to other, non-unionised workers (see Figure 4-1).

[11] The relevant statistical test is not reported.

**Figure 4-1**: Trade union membership by decile




** Note that these figures are based on responses to the survey question and may not exactly match actual union membership. Moreover, almost 3% of the employed did not know whether they were union members and were ignored in the proportions shown here.*
*Source: adapted from Van der Berg (2003)*

### 4.3. (b) Unions and disruptive activity

A survey of large manufacturing firms in the Greater Johannesburg Metropolitan Area by the World Bank (Chandra, Moorty, Rajaratnam and Schaefer 2001) shows that union activity is reasonably disruptive. Table 4-3 summarises the level of disruptive union activity in 1998.

**Table 4-3**: Disruptive union activity

| Number of strikes | Percentage of firms experiencing work stoppages due to union activity | | | |
|---|---|---|---|---|
| | *Small firms* | *Medium-sized firms* | *Large firms* | *All firms* |
| 0 | 75% | 52% | 47% | 58.0% |
| 1 | 17% | 40% | 35% | 30.0% |
| 2 | 8% | 3% | 12% | 8.0% |
| 3 | - | 1% | 6% | 2.0% |
| 4 | - | - | 1% | 0.2% |
| 5 and more | - | 3% | 0.3% | 1% |

*Source: Chandra et al (2001: 36). Small firms are defined as those with less than 100 employees; medium-sized with between 100 and 200 employees and large firms with more than 200 employees*

A large number of workdays, however, are lost to strike action. Of those firms that reported strike action, 53,1 per cent of firms lost more than ten workdays (Chandra *et al* 2001: 36). Losing workdays as a result of union activity increases the non-wage costs of labour.

## 4.4. Wage levels and poverty

The wage-employment dynamic remains one of the most contentious issues in the South African labour market debate. A recent, robust exchange of views between Fedderke, Makgetla and Heintz shows that it important to carefully counter-balance the positive and negative effects of a fall in real wages. The origin of the debate was the view of Fedderke (2003b) that rising real wages have led to sustained job losses in manufacturing. This point was contested by both Makgetla (2003) and Heintz (2003).

Heintz has shown in previous work (Bowles and Heintz 1996) that a fall in real wages of 1 per cent leads to a rise in employment of approximately 0,7 per cent. This, he argues in Heintz (2003), masks the negative consequences that a fall in real wages will have on the wider economy. For example, a fall in real wages will lower disposable income, which in turn will lower consumption. This will in turn lower demand, which will in turn lead to lower employment.

The counter-argument is succinctly set out in SAF (1996). The argument is that lower real wages can be expected to stimulate the demand for labour. This will lead to more jobs being created and the result of this improvement in employment levels will be the eradication of poverty and a large portion of the inequality present in South African society (SAF 1996). The empirical evidence on this point is discussed in more detail in chapters 10 and 11.

### 4.5. Employment versus welfare

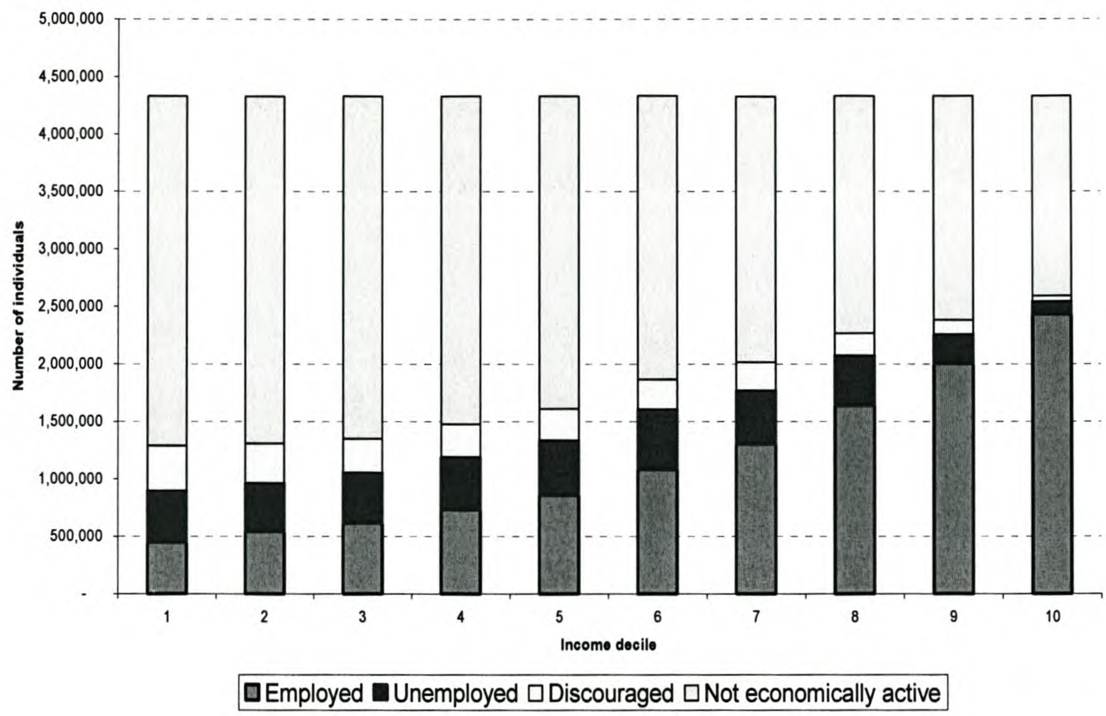
Baskin (1996) has suggested that wage earners are responsible for the welfare of a large number of the unemployed. By reducing wages, the amount of money available for wage earners to distribute to the poor will be reduced.

The intricate relationship between the employed and unemployed is the focus of a paper by Bhorat and Leibbrandt (1996). Using the World Bank/SALDRU 1993 Living Standards Measurement Survey, they demonstrate that wage earners do contribute to the welfare of the unemployed, but not to the extent that is often suggested. The majority of the unemployed (53,3 per cent) are in households with no wage earner at all. Of this group 76,1 per cent are to be found in conditions of poverty. More than half of the unemployed that do find themselves in households with a wage earner are in poor households.

The statement that wage earners support large numbers of the unemployed is thus not completely correct. It would appear that the unemployed tend to find themselves in households where there is no wage earner present. They are also largely below the poverty line. The problem is exacerbated for unemployed black South Africans and for the unemployed in rural areas. Figure 4-2 shows that the employed far outnumber the unemployed in the higher income deciles.

If lower wages could stimulate employment, it would appear that the gains for the unemployed will offset the losses to the unemployed that depend upon wage earners for their income.

**Figure 4-2**: Employment status and decile




*Source: adapted from Van der Berg (2003: Table 6)*

## 4.6. The extent of employment security

Recent legislation to improve the working conditions of the employed (primarily the Basic Conditions of Employment Act and the Labour Relations Act) has been blamed for increasing the non-wage costs of labour and thus bringing about a situation where employing workers is less attractive (see, for example, Barker 1998: 10 *et seq* or Black and Rankin 1998).

The Presidential Labour Market Commission Report also finds that:

> ....anecdotal evidence suggests that many employers are reluctant to employ large numbers of unskilled workers because of the "hassle factor" - the time and management energy involved in dealing with a demanding workforce aware of its rights
>
> *RSA (1996: par. 155).*

Morgan (2001) undertook a cross-country survey of a number of OECD countries. After standardising for macroeconomic conditions, he found that employment security does not necessarily have a dampening effect on employment. That said, the effect of employment security is felt mostly in the speed of adjustment. Economies with high levels of employment security (e.g. Spain) tend to take longer to adjust back onto their trend growth paths after a recession. The flip side is that employment levels take longer to fall as recession looms. In essence, employment security legislation means that the labour market is slower to adjust to cyclical fluctuations, which is a good thing for workers during economic downswings and a bad thing for workers during economic upswings.

The large manufacturing firm survey in the Greater Johannesburg Metropolitan Area showed mixed results for the effect of employment security on employment (Chandra *et al* 2001). Chief Executive Officers report that, after crime and violence, employment regulations are the second biggest constraint to firm growth. Human resource managers have a somewhat different view. It would appear that they argue that employment security makes no *ex post* difference to the decision to employ or not: those that are employed already will not have their chances of being dismissed increased. It does, however, make an *ex ante* difference: The decision to hire is affected by the extent of employment security.

### 4.7. The opening up of the South African economy

It has been widely suggested (e.g. in Bhorat and Hodge 1999 and Bhorat 2003) that the South African economy has undergone a process of 'structural change'. This change has led to structural changes in employment. Mohr (1994) points out that terms such as 'structural change', 'restructuring' and so forth are ambiguous[12]. What precisely is a 'structural change in employment'? Mohr's point is taken and the term 'structural change' will be clearly defined.

In this discussion, structural change is used to refer to the process that occurred between 1990 and 2000. In this period, South African economic policy shifted from an inward-orientation to an outward one (see, for example, Bhorat 2000 or Edwards and Golub 2002). This process saw the end of policy that favoured inefficient domestic industries (such as textiles). With the release of the government's macroeconomic strategy, Growth, Employment and Redistribution (Department of Finance 1996), formalised the policy shift from inward industrialisation to a more outward focus. Domestic industries that produced goods for the export market have been actively encouraged.

Another way of presenting this concept of structural change is taken by Makgetla and Van Meelis (2002). They suggest that there was a break in the South African long-term growth path after 1994[13]. The necessity of this structural change is often forgotten. An analysis of the South African manufacturing industry completed before the political transition (Levy 1992) finds a stagnant manufacturing industry that had neither room for growth nor the means to create jobs. It was bloated, inefficient and over-protected as a result of the previous government's inward-oriented industrial policy. A combination of factors between 1985 and 1995, including a debt standstill and excessively expansionary fiscal policy, had left the fiscus in no position to continue with such a proactive role (see, for example, Fourie *et al* 1993 or Manuel 2003).

Edwards and Golub (2002) point out that there is a public perception that the change in strategy has led to job losses. It is well-known that the Interventionists have had their doubts about pursuing a rapid decrease in the extent of tariff and other trade protection: see, for example, Standing, Sender and Weeks (1996) or Roberts (1998). Edwards and Golub do, however, show that the change in policy focus cannot necessarily be held responsible for job losses.

### 4.8. The inflation – unemployment relationship

The introduction of inflation-rate targeting by the government in February 2000 (see Department of Finance 2000), re-opened a debate on the relationship between inflation and unemployment. The non-inteventionist grouping believes that lower inflation creates an environment for growth; the interventionist grouping believes that there is a trade-off between inflation and employment.

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[12] An earlier paper by the same author, Mohr (1993) points to Machlup who identifies at least 25 different definitions of "structure" in Economics.

[13] Both are attached to the NALEDI, a think-tank of Congress of South African Trade Unions.

The term 'Phillips curve' has come to be applied to the curve describing the relationship between inflation and unemployment. In his seminal article, Phillips (1958) showed that there was a negative relationship between the change in wages ( $\dot{W}$ ) and the level of unemployment ( $U$ ). His results were based on a sample in the United Kingdom between 1861 and 1957.

The Phillips curve debate is, however, not new. As early as 1752, David Hume suggested that:

> ...it is only in the interval or immediate situation, between the acquisition of money and the rise in prices, that the increasing quantity of gold or silver is favourable to industry... The farmer or gardener, that their commodities are taken off, apply themselves with alacrity to the raising of more... It is easy to trace the money in its progress through the whole commonwealth; where we shall find that it must first quicken the diligence of every individual, before it increases the price of labour. (in *Of Money*, quoted in Mankiw 2000: 2).

Within the context of high unemployment in South Africa and an inflation-targeting regime, the issue is a particularly important one at present. Is it possible that actively targeting inflation will lead to job losses? Or, alternatively, as has been suggested on numerous occasions by the present and past Governors of the Reserve Bank (see, for example, Mboweni 1999), will inflation-rate targeting lead to higher growth and better long-run employment prospects?

In the South African case, Black and Leibbrandt (1989) provide a useful overview of the Phillips curve controversy in developing countries. They review developing countries and their experience with inflation-rate targeting[14]. They suggest that in developing countries there is a far higher short-run cost in terms of unemployment in bringing inflation down by even a modest degree through contractionary stabilisation policy. They quote Truu (1986: 348), who suggests the following about South African policy during 1976 to 1977:

> At the time the authorities were pursuing a restrictive demand management policy during a cyclical downswing in economic activity, which is sufficient to account for the observed rise in unemployment. The fact that inflation did not fall suggests that it was now influenced by the supply rather than demand side of the economy. Alternatively put, demand inflation had been replaced by core inflation.

[14] This form of inflation-rate targeting refers to simply reducing the inflation rate within the context of a broader approach to monetary policy. In more recent years 'inflation-rate targeting' has come to mean pursuing an *explicit*, published target that serves as the nominal monetary anchor.

In defence of 'the authorities', this accusation is somewhat unfair. The period 1976 to 1977 was characterised by the aftermath of oil-price shock and stagflation, a situation of both low growth and high inflation. Demand-side management policies were implemented not necessarily only to contain inflation, but also to stabilise the South African economy during a period of extreme world volatility. With hindsight, doing Phillips-curve analyses on data from the seventies is a simplistic way of looking at a very complex period.

The 'accepted' conclusion regarding the Phillips-curve contention is that originally put forward by Friedman (1968). Monetary policy may be able to influence real variables (such as the level of prices and unemployment) in the short-run, but there is no possibility of such an effect in the long-run. This is because economic agents are able to predict the effect of changes in price-level on their wages. They adjust their behaviour accordingly and employment is not affected.

This can be tested by following the approach of Shostak (1981). Using autoregressive analysis, he concludes that there is no trade-off between unemployment and inflation in the long-run. This supports the natural rate hypothesis that unemployment does not deviate from a 'natural level' or 'equilibrium level' in the long-run. As a point of interest, he also finds that it appears that economic agents use information on past inflation to forecast future inflation. A similar conclusion is reached by Du Plessis and Smit (2001: 39). Using co-integration analysis, they find that price expectations tend to be backward looking at the sectoral level. Thus pursuing an overly ambitious inflation rate target may be unsuccessful because of inflation hysteresis.

### 4.9. South Africa is not growing fast enough

Another argument that has been put forward is that South African growth has been insufficient to produce significant levels of employment (e.g. Department of Finance 1996). The proposition is quite simple: the rising output will lead to rising demand for labour. Unfortunately, there is no clear evidence that this has been the case[15]. The focus thus turns to calculating the growth in output that is required to create jobs.

[15] Bhorat (2003), Simkins (2003) and Altman (2003) have argued that there has been some job creation, even though the official time series statistics do not reflect this. The problems with the data are

Using empirical analysis Löbbe (1998), a German economist, has identified employment thresholds for a number of developed countries. By identifying the long-term employment elasticity of an economy, it can be empirically determined how fast a country should grow before the economy begins adding jobs. In the context of the debate on South African employment, the formulation by Löbbe is particularly useful since it uses the level of employment. Similar work, e.g. Burrows and Smit (1999), and Schalk (1998), uses the rate of unemployment in the analysis, which is difficult to measure in the South African context.

The starting point is the assumption the assumption that gross value added, *Y*, is the product of the number of employed, *E*, and the labour productivity, *w*. Re-arranging the expression in terms of the number of employed gives the following result:

$$E = \frac{1}{w}.Y \qquad [\,4\text{-}1\,]$$

The parameters of the following function can be estimated:

$$\mathrm{g}E = a_0 + a_1.\mathrm{g}Y \qquad [\,4\text{-}2\,]$$

where g$E$ and g$Y$ symbolise the annual average percentage change in the number of employed and gross value added respectively. The parameters can be interpreted as follows:

- $a_1$ is the so-called employment elasticity. As the slope of the regression line, it indicates the relative change in the number of employed, given an increase in value added of 1 per cent;
- $(-a_0/a_1)$ is the so-called employment threshold. The quotient of the regression parameters indicates the growth in output that has to be attained if employment is not to fall.

Naturally, the lower the employment elasticity, the flatter the regression line. This could indicate labour market inflexibility – as output decreases, for example,

discussed in more detail in chapter 8 and the estimates of these authors are compared against the employers do not retrench workers. The converse is thus also true, and relatively fast economic growth is required before the significant changes in the level of employment is seen.

### 4.9. (a) Calculated results for South Africa

**Table 4-4:** Löbbe output elasticities and thresholds – South Africa

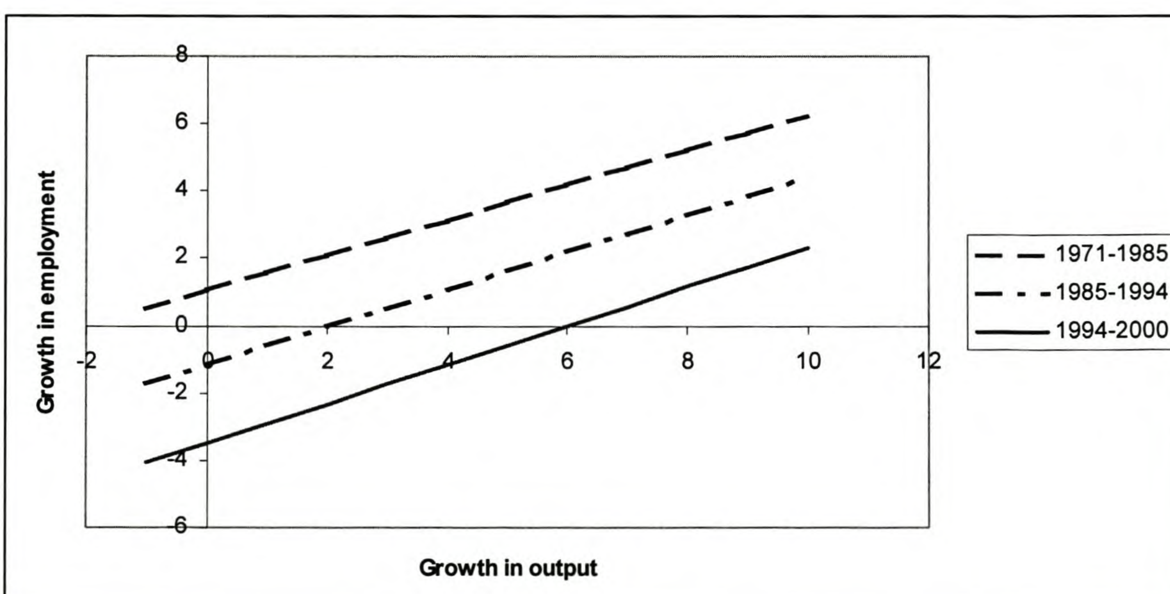
| | **Intercept term** $a_0$ | **Output elasticity** $a_1$ | **Employment threshold** $(-a_0/a_1)$ | **adj-$R^2$** |
|---|---|---|---|---|
| 1971-2000 | -1.22786 | 0.704819 | 1.742086 | 0.41 |
| 1971-1985 | 1.030215 | 0.523267 | -1.96881 | 0.55 |
| 1985-1994 | -1.16031 | 0.554785 | 2.091455 | 0.39 |
| 1994-2000 | -3.49886 | 0.580864 | 6.023536 | 0.18 |

All coefficients are significant at the 5% level

*Source: author's calculations, data from the SARB (Various), cf. section 9.2 below*

The results are sobering. Using this method, it would appear that South Africa needs to grow at an annual rate of approximately 6 per cent before employment will be created. The threshold has risen over time, as is shown in Figure 4-3.[16]

**Figure 4-3**: Employment thresholds, selected periods




official numbers.

[16] A later section argues that this may be due to real wage growth.

*Source: author's calculations, data from the SARB (Various)*

The calculations above indicate that output has to grow at 6 per cent over a four-quarter period before employment will be created.

## 4.10. Conclusion

The chapter highlighted that the present labour market debate is somewhat skewed as a result of ideological bias. This is perhaps to be expected: in essence a labour market pits employers against employees.

The unfortunate result is best summarised by Fields (2000):

> I would note too that the tripartite [business, labour and government] approach to social negotiations in South Africa, as in the rest of the world, leaves out a very important group: those workers who are not employed in the formal sector, who do not belong to trade unions, and who do not have representatives at the bargaining table… What promotes the interests of the unemployed and underemployed is shifting the demand for their labor…

It would appear that the arguments of organised labour and business enjoy centre-stage, with little attention paid to the arguments of the unemployed.

This chapter also concludes the analysis of the microeconomic factors that influence a labour market. It has been established that there are a number of arguments why a labour market does not 'clear' in the Walrasian sense. An understanding of microeconomic issues at play in a labour market is needed in creating a broader understanding of how the labour market functions at a macroeconomic level. The focus now shifts to the aggregate level.

# Part II

## Macroeconomic Analysis

## Chapter 5: From Microeconomics to Macroeconomics

*... while the individual man is an insoluble puzzle, in the aggregate he becomes a mathematical certainty. You can, for example, never foretell what one man will do, but you can say with precision what an average number will be up to.*

Sherlock Holmes in *The Sign of Four* by Sir Arthur Conan Doyle

### 5.1. Introduction

So far the analysis has dealt with the demand for labour at the level of the firm. As it is the stated objective of this thesis to deal with the demand for labour from a macroeconomic perspective, the focus now moves to the aggregate level.

This chapter bridges the gap between the level of the firm and at the level of the macroeconomy by setting out the econometric considerations that need to be taken into account when applying the microeconometric production function approach to aggregate data.

First, the Cobb-Douglas and CES production functions are briefly revisited. Secondly the problems associated with converting a theoretical construct into a usable functional form are then considered in some detail. As production functions are merely abstractions of reality, it is obvious that production functions of any form are subject to important caveats. These caveats are discussed, as are possible ways of overcoming the problems.

### 5.2. Production functions revisited

#### 5.2. (a) The Cobb-Douglas approach

The Cobb-Douglas production function is used extensively for applied work, particularly in the United States (Prescott 2002). The reason is that, under competition, it is the only production function with the property that factor income shares are independent of relative factor prices. This property of the Cobb-Douglas production function is consistent with U.S. data as, historically, the real wage in the

U. S. has risen more rapidly than the price of capital or the relative factor income shares.

As was shown in Part I above, the Cobb-Douglas can be represented as follows:

$$Q = AK^{\alpha} L^{\beta} \qquad [\text{5-1}]$$

and the marginal products of labour and capital are given by:

$$\frac{\partial Q}{\partial K} = \alpha A K^{\alpha-1} L^{\beta} = \alpha \frac{Q}{K} \qquad \frac{\partial Q}{\partial L} = \beta A K^{\alpha} L^{\beta-1} = \beta \frac{Q}{L} \qquad [\text{5-2}]$$

It can also be shown (Thomas 1993) that if the marginal productivity conditions hold, the exponents $\alpha$ and $\beta$ in the Cobb-Douglas production function are equal to the respective shares of capital and labour in the value of output. Indeed, in the late 1920s Douglas noted that the share of US national output going to labour and capital had remained virtually constant and this led to the formulation of the Cobb-Douglas function.

For the purposes of the applied empirical work that will be undertaken in this thesis, it is important to note that the Cobb-Douglas function is restricted in that it implies a constant elasticity of substitution equal to one. Expressed in practical terms, this means that a one per cent increase in the ratio of factor prices must lead to a one per cent increase in the capital to labour ratio.

### 5.2. (b) The Constant Elasticity of Substitution (CES) approach

In specifying the relationship of the Cobb-Douglas production function one is making the explicit assumption that the elasticity of substitution is equal to one. In other words, labour and capital are perfectly substitutable. This may not be true. Skilled labour may be difficult to find and can thus not be a substitute for capital. Arrow, Chenery, Minhas and Solow showed in 1961 that it may not be the case. They thus put forward a production function of the form (Thomas 1993: 303):

$$Q = \gamma[\delta K^{-\theta} + (1-\delta)L^{-\theta}]^{-1/\theta} \qquad [\text{5-3}]$$

The parameters may be interpreted as follows:

- $\gamma$ is an 'efficiency parameter' similar to the $A$ in the Cobb-Douglas production function. For a given $\delta$ and $\theta$, a larger value for $\gamma$ will imply that a greater amount of output $Q$ can be obtained from given inputs of $K$ and $L$.
- $\theta$ is known as the 'substitution parameter'. This is because it can be shown that a 1 per cent rise in the relative factor price (wages to cost of capital) ratio leads to a $(1/1+\theta)$ rise in the capital-labour ratio. That is to say, as labour becomes more expensive, the amount of capital used increases.
- $\delta$ is known as the 'distribution parameter'. This is because as $\delta$ rises, the capital-labour ratio rises. It therefore captures the distribution of output between capital and labour.

The CES function may be generalised to include the possibility of increasing or decreasing returns to scale (see Thomas 1993: 304). That generalisation, however, falls outside the scope of this thesis. For the purposes of the analysis here, constant returns to scale will be assumed.

## 5.3. Theory and practice – General problems

### 5.3. (a) Value-added output

So far, it has been shown that the production function can be a useful way of looking at how labour and capital interact within the context of an industrialised economy. Unfortunately, any production function is a simplification. There is a risk that the production function is over-simplified and this casts doubt on its use.

As Thomas (1993: 305) points out, a firm typically produces more than one output and employs more than two separate factors of production. Raw material and intermediate-good inputs are frequently as important as capital and labour inputs. The assumption that inputs can be treated as completely homogenous in quality is also somewhat of an over-simplification of reality. One issue, which is particularly applicable to South Africa, is that there may be different 'types' of labour – in terms of education and skill. How, for example, does the input of skilled and unskilled labour differ? Even capital suffers from this problem: how does one distinguish between different types of capital – both in terms of efficiency and in terms of application?

Even if data was available (which is unfortunately not the case in South Africa), there are potentially severe multi-collinearity problems. Some form of aggregation is thus necessary.

Thomas (1993: 305) suggests working in terms of real output originating in the firm – or value added. In his context, this is defined as:

$$V = \overline{Q} - \overline{M} \qquad [\text{ 5-4 }]$$

where

$$\overline{Q} = \sum_{i=1}^{n} p_i Q_i \quad \text{and} \quad \overline{M} = \sum_{i=1}^{s} v_i M_i \qquad [\text{ 5-5 }]$$

$\overline{Q}$ and $\overline{M}$ are weighted measures of real output and total intermediate input respectively. The parameters $p_i$ and $v_i$ are the real prices of the $i$th output $Q_i$ and $i$th intermediate output of $M_i$.

Value added, $V_i$, is then expressed as a function of single indices $\overline{K}$ and $\overline{L}$ (themselves weighted averages of the individual capital and labour inputs). Algebraically, one can express this as follows:

$$V = V(\overline{K}, \overline{L}) \qquad [\text{ 5-6 }]$$

It would appear that the formulation above is close enough to the very general specification for a production function. It is a somewhat simple step to move from value added to total production – one simple adds the intermediate goods, as follows:

$$\overline{Q} = \overline{M} + V(\overline{K}, \overline{L}) \qquad [\text{ 5-7 }]$$

### 5.3. (b) Aggregate production functions

Production functions were originally developed for firm-level data. As a result, there are some conceptual issues that need to be considered when dealing with an aggregate production function (Thomas 1993: 306).

Consider the case of a production function for a single industry. It is not unreasonable to assume that the range of possible production techniques is similar across the industry. It is possible, therefore, to suspect that the exponents $\alpha$ and $\beta$ in a production function are the same (or nearly the same) amongst all the firms.

There are, however, still a number of problems (Thomas 1993):

i. **Incorrect means**: When applying the Cobb-Douglas function, the traditional approach is to render a multiplicative, non-linear relationship into a linear one by using logarithms. The mathematics is beyond the scope of this thesis, but it can be shown that sensible aggregation requires that the macro-variables are defined as the geometric rather than the arithmetic means of the corresponding micro-variables.

ii. **Marginal productivity conditions**: The production function is one of a system of three simultaneous equations, the other two equations being the marginal productivity conditions. It thus follows that it is not enough to only aggregate the production function, but the marginal productivity conditions must be aggregated too. Although this is possible, it is not always clear how credible it is to aggregate marginal productivity conditions.

iii. **External economies of scale**: The assumption is that firms within the industry function under conditions of constant economies of scale. However, once one has aggregated to the level of the industry it is not unreasonable to suspect that there may be external economies of scale present – in short, the whole is greater than the sum of the parts.

Unfortunately, some of the production functions that will be estimated have the further complication of encompassing a number of industries. A number of further complications may thus exist. One can extend the previous list by including the following new problems (Thomas 1993: 306):

iv. **Different types of output and inputs**: Available techniques of production may be significantly different between industries. As a result, it is no longer reasonable to assume that $\alpha$ and $\beta$ coefficients in a Cobb-Douglas production function (for example) will hold across the entire economy, or even across sectors;

v. **Capital intensity**: Different industries may have different levels of capital intensity. High values of $\alpha$ are likely to be associated with high values of $K$ and similarly for $\beta$ and $L$. Clearly capital inputs are greatest in capital-intensive industries and labour inputs in labour-intensive ones.

vi. **Different rates of expansion**: The problem of different levels of capital intensity would not be so severe in time-series analysis if at least the correlations between $K$ and $\alpha$ and $L$ and $\beta$ stayed constant over time. Different industries, however, tend to expand at different rates. As a result, the expansion of total outputs will depend on how the increased inputs are distributed across industries. For example, the increase in output will be greater if the capital inputs go to capital-intensive industries where they will be used more efficiently.

The list above is not complete and there are further concerns with aggregate production functions (see, for example, those raised by Prescott 2002). Thomas (1993) goes so far as to describe any production function as 'nebulous' and says that the relationships are 'hazy' at best. In estimating an aggregate production function one is by no means trying to explain the working of a large, diversified economy (or even a small, open one). Rather, one is trying to get a better understanding of how the different inputs interact. Essentially one is only getting a useful statistical description of the relationships between aggregate $Q$, $K$ and $L$. In the case of this thesis the concern is particularly $L$ and how it reacts to changes in $Q$ and $K$.

### 5.3. (c) Measurement concerns

The focus now shifts to the problem of measuring the quantities in the production function. This is an important problem: aggregate production functions assume that the variables are **flow** variables and not **stock** ones.

In the international literature, the flow of labour inputs ($L$) is usually measured in terms of man-hours (Thomas 1993: 307). This is no South African data on man-hours worked and even the data on the number of workers employed is patchy (for some of these problems see Klasen and Woolard 1998, Makgetla and Van Meelis 2002, Nicolau 2002 and Aliber 2003).

Thomas (1993) proposes using a weighted measure of total labour input. He suggests that appropriate weights would be base-period hourly-wage rates for the different types of labour, provided that these weights adequately measure the relative usefulness of the various labour flows in the process of production.

There are similar problems measuring the flow of output, $Q$. It is possible, for example, to weight output flows using market prices on the assumption that these best represent the relative prices of different inputs to society.

The largest area if concern, however, is that of capital inputs. Once again the production function specifies the flow of capital, but the data tends to be on the stock of capital. Similar to the flow of labour there may be different qualities of capital: one industry might rely on up-to-date computer technology, another on ageing mining equipment. There are also concerns about how quality changes. Quality may improve with technology or deteriorate as a result of depreciation.

## 5.4. Specific problems with production functions

### 5.4. (a) Problems relating to econometrically estimating a Cobb-Douglas production function

A production function using time-series data is different from a cross-sectional one in one important aspect. This is the treatment of technology. In the cross-sectional case, it can be assumed that technology is given and unchanging. In the time series case it is important to account for changes in technological knowledge over time. The firm's production possibility frontier will shift as the firm becomes more efficient.

Thus the standard Cobb-Douglas function becomes the following:

$$Q_t = A_t K_t^{\alpha} L_t^{\beta} \varepsilon_t \qquad [\text{ 5-8 }]$$

where technology $A$ is now expressed as a function of time. The expression also now includes $\varepsilon_t$, which is an error-term for random disturbances.

Before the function can be estimated econometrically, some form has to be given to the term $A_t$. Thomas (1993) suggests that in practice this has most often been of the following form:

$$A_t = Ae^{gt} \qquad [5\text{-}9]$$

where $A$ and $g$ are constants. The Cobb-Douglas production function can then be re-specified as follows:

$$Q_t = Ae^{gt}K_t^{\alpha}L_t^{\beta}\varepsilon_t \qquad [5\text{-}10]$$

It can be shown that $g$ is merely the rate at which output changes over time assuming $K$ and $L$ are constant. In other words, $g$ measures the rate of technical progress.

Taking logarithms yields:

$$\ln Q_t = \ln A + gt + \alpha \ln K_t + \beta \ln L_t + \ln \varepsilon_t \qquad [5\text{-}11]$$

Thus the estimation of equation [5-4] simply requires the inclusion of a time trend into the usual Cobb-Douglas framework.

There are limitations (Thomas 1993: 318):

i. The inclusion of a time trend suggests that technical progress occurs at a constant rate – this is possibly unrealistic.

ii. The technical progress may be non-neutral. This implies that technical progress may have an effect on the substitution between labour and capital.

iii. The technical progress may not be exogenous, thus technical progress through learning-by-doing, for example, is excluded.

The persistent problem of multi-collinearity still exists – in the case of large firms, for example, high levels of capital may be highly correlated with large labour inputs. This problem can be overcome to a degree by re-specifying the equation in terms of (*Q/L*). This approach, however, will not be particularly useful in the context of this thesis, however, since the variable of concern is *L*.

5.4. (b) Extensions to the Cobb-Douglas production function

There have been a number of structural shifts in the South African economy and as a result econometric modelling becomes problematic[17]. In terms of the labour force, changes in the quality of the labour force need to be taken into account[18]. One extension to the standard Cobb-Douglas function does indeed attempt this. In this extension, which was first used by Hildebrand and Liu in 1965, the parameters $\alpha$ and $\beta$ are allowed to vary[19].

A function can be estimated of the following kind (Thomas 1993: 321):

$$Q_i = AK_i^{\alpha(\log R_i)} L_i^{\beta(\log S_i)} \varepsilon_i \qquad [5\text{-}12]$$

where the additional variables $R_i$ and $S_i$ are measures of the quality of labour and capital respectively.

The most influential extension of the Cobb-Douglas production function, however, remains that of Robert Solow (Romer 1996: 9 *et seq*). The model was developed into a version that includes quality of the labour force by Mankiw, Romer and Weil (1992).

In this extension of the production function, Mankiw *et al* (1992: 409) begin by assuming a production function similar to Cobb-Douglas one above. The most important difference is that the economy-wide technology term is replaced with a term for labour productivity:

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[17] Dealing with structural change within a co-integration framework is discussed in Part III.

[18] The educational profile of the labour force, for example, has changed significantly over time. The early part of the twentieth century was characterised by an unskilled labour force predominantly engaged in primary industries (Terreblanche 2003). As a result of Apartheid, education levels remained low. Not only has the economy changed structure (as discussed in an earlier chapter), but the labour force has evolved too.

$$Q_t = K_t^{\alpha}(A_t L_t)^{1-\alpha} \qquad [\ 5\text{-}13\ ]$$

Labour and technical knowledge are assumed to grow exogenously at rates $n$ and $g$, respectively. A constant fraction of output, $s$, is invested. By assuming that the stock of capital per effective unit of labour converges to a steady state, $k^*$, an equation for this steady-state can be derived:

$$k^* = [\ s\ /\ (\ n + g + \delta)\ ]^{\ 1\ /\ (1\ -\ \alpha)} \qquad [\ 5\text{-}14\ ]$$

By substituting [5-14] into [5-13], and taking the logarithm of both sides, the steady-state income per capita can be expressed as:

$$\ln\left[\frac{Q_t}{Lt}\right] = \ln A_0 + gt + \frac{\alpha}{1-\alpha}\ln(s) - \frac{\alpha}{1-\alpha}\ln(n+g+\delta) \qquad [\ 5\text{-}15\ ]$$

By assuming that ln $A_0$ is equal to a constant α and a country-specific shock, ε, the model specification is:

$$\ln\left[\frac{Q}{L}\right] = \alpha + \frac{\alpha}{1-\alpha}\ln(s) - \frac{\alpha}{1-\alpha}\ln(n+g+\delta) + \varepsilon \qquad [\ 5\text{-}16\ ]$$

Adding human capital to $k^*$ yields a model which includes both the rate of accumulation of human capital ($s_H$) and level of human capital ($h^*$) as predictor variables. Since it can be argued that ε in [ 5-16 ] includes the level of human capital, $h^*$, for the purposes of specifying a model, $h^*$ can be omitted.

As the Solow / Mankiw-Romer-Weil version considers the growth in employment to be exogenous, the extension presented above is clearly of little use in the context of this thesis.

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[19] The study was a cross-sectional one where labour force quality varied across states in the United States. The principle is also, however, applicable across time.

### 5.4. (c) Problems relating to econometrically estimating a CES production function

There are additional difficulties when estimating a CES production function (Thomas 1993: 326). Unlike the Cobb-Douglas, a CES cannot be made linear using a simple logarithmic transformation. The first empirical attempt, by Solow *et al* (1961, quoted in Thomas 1993) begins by estimating the following:

$$\frac{Q}{L}=\left(\frac{\gamma^{\theta}}{1-\delta}\right)^{1/1+\theta}\left(\frac{w}{p}\right)^{1/1+\theta} \qquad [\ 5\text{-}17\ ]$$

By using the elasticity of substitution formula $\sigma = 1 / (1 + \theta)$ and transforming the above into log form the following can be derived:

$$\log\left(\frac{Q}{L}\right)=\sigma\log\left(\frac{\gamma^{\theta}}{1-\delta}\right)+\sigma\log\left(\frac{w}{p}\right) \qquad [\ 5\text{-}18\ ]$$

$\sigma$ is the co-efficient of substitution. In a cross-section of industries across different states in the U. S., Solow *et al* (1961) showed that in almost half the cases the co-efficient of substitution was less than one. In other words, the assumption of unitary substitution that the Cobb-Douglas production function makes is not necessarily valid.

The time-series version is a simple extension to the cross-sectional version above. The above can be re-arranged so that:

$$\frac{wL}{pQ}=(1-\delta)^{\sigma}\gamma^{\sigma-1}\left(\frac{w}{p}\right)^{1-\sigma} \qquad [\ 5\text{-}19\ ]$$

Assuming neutral technical progress at a constant rate $g$, so that the efficiency parameter may be written as $\gamma=\gamma_0 e^{gt}$, a logarithmic transformation of the above yields:

$$\begin{aligned}\log\left(\frac{wL}{pQ}\right)&=\sigma\log(1-\delta)+(\sigma-1)\log\gamma_0+(1-\sigma)\log\left(\frac{w}{p}\right)+(\sigma-1)gt\\&=const+(1-\sigma)\log\left(\frac{w}{p}\right)+(\sigma-1)gt\end{aligned} \qquad [\ 5\text{-}20\ ]$$

Alternative functional forms include the Kmenta version of the CES, which uses a Taylor series expansion around $\theta = 0$ (Thomas 1993: 329).

$$\log Q = \log \gamma + \delta \log K + (1-\delta)\log L - \frac{1}{2}\theta\delta(1-\delta)\left[\log\left(\frac{K}{L}\right)\right]^2 \qquad [\text{ 5-21 }]$$

assuming constant returns to scale.

This is the most attractive version of the CES production function. The reason is that in the absence of the last term, the equation above is simply a Cobb-Douglas production function. If the last term is statistically significant, then it indicates that a CES function should be used. If it is not, then the Cobb-Douglas is sufficient.

## 5.5. Choosing the production function

The choice of production function is particularly important to ensure that the econometric specification is correct. Du Toit and De Wet (2002) have shown that the Cobb-Douglas production function is indeed the correct specification for the South African economy. Their approach is to estimate the different possible production functions econometrically and then to analyse which production function best fits the aggregate macroeconomic data. Although unpublished, work by the National Treasury and Bureau of Economic Research on production functions has also indicated that a Cobb-Douglas production function best describes the functioning of the South African economy.

## 5.6. Conclusion

As was shown in chapter 2, production functions are at the heart of analysing the demand for labour at the level of firm. It is found that, used with care, production functions are capable of performing this function at the level of the macroeconomy too. Either of the two 'workhorse' production functions can be used for this purpose: the Cobb-Douglas or the CES.

There is evidence that a Cobb-Douglas production function is the most suitable for South African analyses. This does not preclude the use of the CES in labour market studies – the literature production functions at the sectoral level is rather limited in the South African context[20].

This chapter served to link the microeconomic and macroeconomic literature. The microeconomic literature focuses, unsurprisingly, on the factors underpinning the behaviour of individual agents in the labour market. The most important problem of aggregation is that it is very difficult to capture the microeconomic rigidities within a macroeconomic framework. Insider-outsider power, for example, may only be present in a few industries. Similarly, other industries may be characterised by efficiency wages. Any economy is a large and complex beast, and the macroeconomic labour market is equally, if not more, complicated.

The following chapter considers how the literature has addresses this issue from a theoretical point of view. It considers three models that analyse the labour market at the macroeconomic level. The theoretical analysis is followed by a chapter that considers how the empirical literature addresses the issue.

[20] Two studies that use a CES specification, Fallon (1992) and Fallon and Lucas (1998), are discussed in chapter 7 below.

# Chapter 6: Theoretical Macroeconomic Models of the Labour Market

## 6.1. Introduction

The previous chapter took the level of discussion from the micro-level to the macro-level. It served to highlight the technical problems of aggregation, paying particular attention to the production function literature. There are not only technical aggregation problems, but conceptual ones too. For example, a strong theoretical argument for the existence of insiders and outsiders can be made at the microeconomic level. But how does this relate to the interaction of macroeconomic variables, particularly employment?

This chapter considers three theoretical macroeconomic models of the labour market. Following the scheme of the earlier chapters, firstly an approach in a more neo-classical tradition will be discussed. This is a simple five-equation model set out by Blanchard and Fischer (1996). Thereafter this model will be extended to include the presence of labour-market 'peculiarities' – such as insiders and outsiders. The model in this tradition is that of Layard, Nickell and Jackman (1991). This model provides a particularly useful way of combining micro- and macroeconomic concerns into a coherent theoretical structure. The final model considered is that of Agénor, Izquierdo and Fofack (2002). This model can be seen as a highly developed framework in the structuralist tradition. It attempts to incorporate a range of rigidities, particularly those that are unique to developing countries.

## 6.2. A basic neoclassical model with some rigidity

Blanchard and Fischer (1996: 518) set out a five-equation system to allow for a theoretical analysis of economic fluctuations in the presence of nominal rigidities.

### 6.2. (a) The system of equations

$$y^d = m - p + v \qquad [\,6\text{-}1\,]$$

$$y^s = \beta(p - w + u) \qquad \beta > 0 \qquad [\,6\text{-}2\,]$$

$$l^d = \gamma(p - w + \alpha u) \qquad \gamma > 0, 0 \leq \alpha \leq 1 \qquad [\,6\text{-}3\,]$$

$$l^s = \delta(w - p) \qquad \delta \geq 0 \qquad [\,6\text{-}4\,]$$

$$w \mid El^d = El^s \qquad n = l^d \qquad [\,6\text{-}5\,]$$

where $y$, $l$, $w$, $p$ and $m$ denote the natural logs of aggregate output, employment, the wage rate in nominal terms, the price level and money supply. In addition to these variables, $u$ and $v$ are supply and demand shocks. As it is set out above, constants are omitted for the sake of simplicity and implicitly all variables are indexed by time, $t$.

### 6.2. (b) The mechanics of the system

Equation [6-1] expresses the quantity theory of money in logarithmic form. It specifies demand as a function of money supply, the price level and the velocity of money. The next two equations, [6-2] and [6-3], set out output supply and the demand for labour as a function of the real wage and a technological shock. These two equations implicitly assume profit maximising firms functioning under conditions of perfect competition. The co-efficients of the equations – $\beta$, $\gamma$ and $\alpha$ – depend on technology and are likely to be related[21]. The way in which wages are set is determined by equations [6-4] and [6-5]. The former equation considers the supply of labour, which may be expressed as a function of the real wage rate ($W$ / $P$). The latter equation introduces rigidity – the nominal wage is set to equalise the expected labour demand and expected labour supply. Given the nominal wage, employment is determined by labour demand and wages are taken to be exogenous. This is a peculiarly Keynesian rigidity and relates back to the discussion in section 3.2, particularly equation [3-4], where the equilibrium wage rate is not set by the forces of supply and demand, but rather outside of the system.

Indeed, it is possible to use the system of equations to derive the level of the nominal wage. This can be done by substituting equations and then taking expectations, conditional on the set of information.

[21] Blanchard and Fischer (1996) propose that a technology production function can be used to derive this relationship. Consider the special case of constant returns to labour – here the price depends only on the wage and technological shock and not on the level of output.

$$w = Ep + \left(\frac{\alpha\gamma}{\delta + \gamma}\right)Eu \qquad [\,6\text{-}6\,]$$

Changes in nominal wages are equal to the changes in the expected price level plus a non-decreasing function of the change in expected technological shock. Equation [6-6] sets this out in levels. Unless labour supply is perfectly elastic, an expected positive shock leads to an increase in both employment and wages. This is a particularly important result in the South African context. Wages are most often set by bargaining councils (Kingdon and Knight 1999: 1) and firms make employment decisions on the basis of these wages. Smaller firms, particularly, have little or no input into wage negotiations.

Continuing further, one can substitute this new function for wages into equation [6-5] and utilising the quantity theory of money set out in equation [6-1], one can derive a function for output, $y^s$. The quantity theory is re-stated for convenience in equation [6-7].

$$y^d = m - p + v \qquad [\,6\text{-}7\,]$$

$$y^s = \beta(p - Ep) + \beta(u + aEu) \qquad [\,6\text{-}8\,]$$

$$\text{where } a \equiv \frac{\alpha\gamma}{\delta + \gamma}$$

One now has a system in which one can better consider what influence sticky wages have on a macroeconomic system. As is shown in equation [6-8], output supplied depends on both the unexpected movements in the price level (cf. the discussion after equation 3-11 on unexpected inflationary shocks).

This provides a simple aggregate demand-aggregate supply system, that has been successfully used to investigate a number of supply and demand issues – most notably the 1973 oil shock and the effect of wage indexation (see, for example, Gray 1976).

### 6.3. Beyond the neoclassical model

Although a broadly neoclassical model set out above provides a useful way of considering nominal rigidities such as an exogenous wage, it is not fully able to incorporate further characteristics of the labour market, such as those discussed in chapter 3. Layard, Nickell and Jackman (1991: 366) propose a somewhat more detailed macroeconomic system, which does make an attempt to incorporate labour market peculiarities.

### 6.3. (a) The system of equations

*Production*

$$y - k = \alpha(n - k) + \varepsilon \qquad [\,6\text{-}9\,]$$

$$\bar{y} - k = \alpha(l - k) \qquad [\,6\text{-}10\,]$$

*Output*

$$y = y_d \qquad [\,6\text{-}11\,]$$

$$y^P = -\eta(p - Ep) + y_d^e \qquad [\,6\text{-}12\,]$$

*Demand*

$$y_d = \sigma_1 x + \sigma_2 (m - p) \qquad [\,6\text{-}13\,]$$

*Expected demand*

$$y_d^e = \sigma_1 x + \sigma_2 (m^e - Ep) \qquad [\,6\text{-}14\,]$$

*Pricing*

$$p - w^e = b_0 - b_1(y_d^e - \bar{y}) + b_2(y^P - k) \qquad [\,6\text{-}15\,]$$

*Wages*

$$w = \lambda[p - b_{01} + b_2\alpha(k - n_{-1})] + (1 - \lambda)(w^e + c_0 - c_i u - c_2 \Delta u + c_3 \hat{z}_w) + \hat{z}_{1w} \qquad [\,6\text{-}16\,]$$

*Unemployment*

$$u = l - n \qquad [\,6\text{-}17\,]$$

The wage determination equation, [6-16], is the key component of this particular model and will be discussed separately and in more detail below. In the rest of the system, the endogenously determined variables are $y$ for output, $\bar{y}$, the full employment level of output, $y_d$, the level of demand, $y^P$, the planned level of output and $n$, the level of employment. The following variables are exogenously determined: $k$ (capital stock), $l$ (labour force), $m$ (the money stock), $m^e$ (the expected money stock), $x$ (the fiscal stance), $x^e$ (the expected fiscal stance), $\hat{z}_w$ (employment benefits), $\hat{z}_{w1}$ (unionisation), $n_{-1}$ (lagged employment), $\varepsilon$ (the stochastic error term), $w^e$ (expected wages) and $Ep$ (expected prices).

Throughout, an $e$ superscript denotes expectations and $t$ subscripts for time are omitted for the sake of convenience.

### 6.3. (b) The mechanics of the system

The system functions in broadly the same way as that of Blanchard and Fischer (1996) set out above. It is useful to firstly consider which variables are exogenously determined.

Layard *et al* (1991: 367) show intuitively how the model determines unemployment. Given these variables, equation [6-14] determines expected demand. Then equations [6-10], [6-12], and [6-15] determine prices, which are set at the beginning of the period. During the period [6-11] gives actual demand, which in turn determines output in [6-13] and employment, via the production function [6-9]. Unemployment is then determined through the identity [6-17]. Finally, wages are then determined through [6-16].

### 6.3. (c) Wage determination

As indicated above, the wage determination equation, [6-16], is the most important contribution that this particular theoretical model makes, because it provides a tractable way of taking into account labour market-specific distortions.

They begin by considering the presence of insider-outsider power.

Equation [6-9] above gives the relationship between expected product wages and planned output. Planned employment, $n_i^p$, is the number of workers required by the firm to produce planned output. From this one can derive a relationship between the expected product wage and planned employment as follows:

$$p_i - w_i^e = b_0 - b_1(y_d^e - \bar{y}) + b_2\alpha(n_i^p - k_i) \quad [\,6\text{-}18\,]$$

This is derived from substituting a production function into equation [6-15].

Layard *et al* (1991: 364) define the 'insider' wage as the wage that would lead the firm to employ the $n_{Ii}$ insiders who are party to the bargain. The insider wage, $w_i^I$, is given by

$$w_i^I = p_i - b_0 - b_1(\overline{y}_d - \overline{y}) - b_2\alpha(n_{Ii} - k_i) \qquad [\,6\text{-}19\,]$$

This defines the wage that would allow employment to stabilise at $n_{Ii}$, or put another way, the level where the wage is high enough to ensure that the insiders keep their jobs.

So far this is a 'pure' insider model in the tradition of Blanchard and Summers (1986). But other factors influence the wage.

These factors may be linked to the need that firms have to recruit, retain and motivate their workforces (Layard *et al* 1991: 365), a version of the efficiency wages theory discussed in section 3.4. On the other hand, there are also search-and-matching considerations to take into account. As was shown in section 3.6, the search-and-matching literature suggests that wages could be a factor of wages available elsewhere modified by the chances of obtaining a job and the attractiveness of the unemployed state.

Layard *et al* (1991: 365) thus suggest that this is the 'outsider wage', determined by the market and not by worker influence. It yields an expression as follows:

$$w_i^o = w^e + c_0 - c_1 u - c_2 \Delta u + c_3 \hat{z}_w \qquad [\,6\text{-}20\,]$$

where $u$ 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.

Equation [6-20] includes a term for the expected total wages. This is as a result of the assumption that when wages are determined, full information about the aggregate wage is not available. In addition, the measure of the chances of obtaining another job depends not only on the unemployment rate, but also changes in the rate. This is because it may be harder to obtain work if unemployment has recently risen (i.e. if $\Delta u > 0$), because there will be more competition for jobs. This captures the effect that more recently unemployed people are more active in looking for work and more attractive to firms compared to the longer-term unemployed.

The wage outcome ($w_i$) is naturally the sum of the insider and outsider wage:

$$w_i = \lambda[p_i - b_{01} + b_2\alpha(k_i - n_{i-1})] + (1-\lambda)(w^e + c_0 - c_i u - c_2\Delta u + c_3\hat{z}_w) + \hat{z}_{1w} \quad [6\text{-}21]$$

The additional variable is $\hat{z}_{1w}$ which reflects other exogenous factors that could possibly influence wages. There are two particular possibilities (Layard *et al* 1991: 366). The first is unionisation; the second, taxes on wages.

This completes the Layard *et al* (1991) model of prices, wages and output at the level of the firm and the following model that will be considered looks at developing country-specific factors.

## 6.4. Introducing developing country characteristics

The final theoretical macroeconomic model to be considered is that of Agénor, Izquierdo and Fofack (2002). It can be seen as a further development of the theoretical models presented so far, with the exception of the fact that it considers the labour market within the context of a developing economy. The model is the outcome of a process to better understand the linkages between micro- and macroeconomic conditions, and is known as an 'Integrated Macroeconomic Model for Policy Analysis', or IMMPA, approach. It is meant to be a:

> ...dynamic, quantitative macro framework designed for the analysis of the impact of adjustment policies on poverty and income distribution...
> Agénor *et al* (2002: 1)

It is designed to be broadly applicable to poor countries and may not be completely applicable in the context of a middle income country like South Africa. It is presented, however, because it provides a number of interesting insights into how microeconomic processes can be integrated in a macroeconomic model. In keeping with the scope of the thesis, only the employment and wage portions of the model are presented.

### 6.4. (a) Wages, Employment, Migration and Skills Acquisition

The IMMPA developed by Agénor *et al* (2002) has two types of workers: skilled and unskilled.

The assumptions of the model are:

- Unskilled workers may be employed either in the rural economy, $U_R$, or in the urban economy, $U_U$;
- Skilled workers are employed only in the urban economy;
- Skilled workers are not employed in the informal economy.

### 6.4. (b) Rural Wages and Employment

In the rural areas of many developing countries, there appears to be a significant discrepancy between wages paid in the tradables sector and in the non-tradables sector (Agénor *et al* 2002). If one were to assume no skill differential between rural workers in the two sectors, it would naturally follow that workers would first seek employment in the more lucrative export sector. Consider first nominal wages in the export sector, $W_{AT}$, which are indexed by a price deflator, as follows

$$W_{AT} = \overline{w}_{AT}\left(PIND_{AT}\right)^{ind_{AT}} \qquad [\text{ 6-22 }]$$

where $PIND_{AT} = PV_{AT}$, $PX_{AT}$, or $PLEV$, and $0 \leq ind_{AT} \leq 1$, with $PV_{AT}$( $PX_{AT}$ ) being the price of value added (gross output) in the export sector, and $PLEV$ the consumer price index, which are defined below[22].

[22] Note that if wages are indexed to the price of value added $(PIND_{AT} = PV_{AT})$, changes in the price of any intermediate input to the sector would have no effect on their behaviour.

Given at least some degree of bargaining power, workers are able to fully index their wages to inflation so that $PIND_{AT} = PV_{AT}$, and $ind_{AT} = 1$ (this may not be true for all countries, however). The result is that the product wage, $w_{AT}$, is fixed in real terms. Given then that firms are able to hire according to their labour demand curve, the profit-maximising demand function for labour in the tradables sector, $U^{d}{}_{AT}$, can be derived as:

$$U^{d}{}_{AT} = \left( V_{AT}{}^{1+\frac{PXAT}{1-\eta xAT}} \frac{1-\eta x_{AT}}{(1+1L_{-1})w_{AT}} . \frac{\beta_{XAT}}{\alpha^{PXAT}_{XAT}} \right)^{\frac{1}{1+PXAT}}, \text{ where } w_{AT} = \frac{W_{AT}}{PV_{AT}} \qquad [\ 6\text{-}23\ ]$$

This is simply a more developed version of a standard labour demand function, where the demand for labour is positively related to the level of net output, $V_{AT}$, and negatively related to the effective product wage, $(1+IL_{-1})w_{AT}$. Most importantly, labour demand does not depend directly on the price of the exported agricultural good, $PX_{AT}$ .

In addition, a cost of capital variable has been incorporated in the model, by multiplying the product wage rate by $(1+IL_{-1})$, where $IL_{-1}$ is the one-period lagged bank lending rate. Agénor *et al* (2002) point to the literature in the New Structuralist tradition which notes that in credit-in-advance economies, firm may have to use borrowed working capital to pay wages in advance of the sale of output.

The level of employment in the non-tradables sector is then the residual:

$$U^{8}{}_{AN} = U_{R} - U^{d}{}_{AT}. \qquad [\ 6\text{-}24\ ]$$

In the non-traded agricultural sector, wages are flexible and equate labour demand, the total level of employment, $U^{d}_{AN}$, and labour supply. One can then derive the market-clearing equilibrium product wage, $w_{AN}$, as being given by,

$$w_{AN} = \frac{\beta_{XAN}(1-\eta_{XAN})}{\alpha^{PXAN}_{XAN}} \left( \frac{V_{AN}{}^{1+\frac{PXAN}{1-\eta XAN}}}{(U^{8}_{AN})^{1+PXAN}} \right), \text{ where } w_{AN} = \frac{W_{AN}}{PV_{AN}}. \qquad [\ 6\text{-}25\ ]$$

Agénor *et al* (2002) then propose that the size of the labour force in the rural sector, $U_R$, is 'predetermined at any given point in time'. But, naturally, the size of the labour force will rise at the (exogenous) population growth rate after taking in account worker migration to urban areas, MIGR

$$U_R = U_{R,-1}(1+\bar{g}_R) \text{ - MIGR.} \qquad [\text{ 6-26 }]$$

Agénor *et al* (2002) quote the traditional analysis of Harris and Todaro (1970): the decision to migrate is based on the ratio of the average expected *consumption* wage in rural areas to that prevailing in urban areas.

### 6.4. (c) Urban Wages and Employment

Similarly, urban unskilled workers have two choices: they can work in the formal economy and receive a minimum wage, $W_M$, or they can work in the informal economy and be paid the market-determined wage in that sector, $W_I$. In making the decision as to which sector they should work in, they consider:

- The probability of being employed in the sector; and
- The expected purchasing power in the rural area versus purchasing power in the urban area.

Agénor *et al* (2002) then combine these two considerations. This is done by working from the implication that the average expected nominal urban consumption wage is a weighted average of the minimum wage in the formal sector and the going wage in the informal sector. The real wage is simply the nominal wage deflated by the most relevant deflator, the urban consumption price index, $P_{UU}$ (defined below).[11] Using the fact that $\theta_U$ is the probability of finding a job in the urban formal sector, the expected real wage for an urban unskilled worker in the current period ($E_{WU}$) is given by:

[11] The weights of each type of good in the price index represent consumption patterns for urban unskilled workers in the base period (see the discussion below).

$$E_{WU} = \frac{\theta_U W_{M,-1} + (1-\theta_U) W_{I,-1}}{P_{UU,-1}}, \qquad [\,6\text{-}27\,]$$

A similar line of argument is used to calculate the expected rural consumption real wage, $E_{WA}$:

$$E_{WA} = \frac{\theta_R W_{AT,-1} + (1-\theta_R) W_{AN,-1}}{P_{R,-1}} \qquad [\,6\text{-}28\,]$$

where $P_R$ is the consumption index for the rural sector (defined below) and $\theta_R$ is approximated by the initial proportion of the rural unskilled labour force employed in the export sector (that is $\theta_R = U_{AT,0} / U_{R,0}$). The migration function can therefore be specified as

$$MIGR_t = U_{R,-1\lambda m}\left[\sigma_M \text{ In } (\frac{E_{WU}}{E_{WA}})\ \right] + (1-\lambda_m)\frac{U_{R,-1}}{U_{R,-2}} MIGR_{-1}, \qquad [\,6\text{-}29\,]$$

where $0 < \lambda_m < 1$ measures the speed of adjustment and $\sigma_M > 0$ measures the elasticity of migration flows with respect to expected wages.

6.4. (d) Urban Unskilled Wages and Employment

The level of employment in the public sector, $U_G$, is exogenous and public sector workers are paid the same as private sector workers. In addition, a legally binding minimum wage is in place, so that:

$$W_M = \overline{w}_M (PIND_M)^{indM},$$

where $PIND_M = PLEV$ for instance, and $0 \leq ind_M \leq 1$.

Similar to above, the demand for labour is determined by profit maximisation. In addition, the same assumption as above holds in terms of firms that borrow in advance to finance the wage bill, so that the price of labour includes the bank lending rate. Unskilled demand for labour in the private sector is given as follows:

$$U_P^d = T_1\left(\frac{1}{(1+IL_{-1})\overline{w}_M}\frac{\beta_{XP1}}{\alpha_{XP1}^{\rho xp1}}\right)^{\sigma XP1}, \text{ where } \overline{w}_M = \frac{W_M}{PT_1}. \qquad [\,6\text{-}30\,]$$

Similar to the assumption above, it is assumed that the wages in the formal urban sector are always higher than wages paid in the informal sector. The actual level of employment in that sector is determined according to the equation above, whilst the remainder of the urban unskilled labour force, $U_U$, seeks employment in the informal economy, where there are no barriers to entry:

$$U_1^8 = U_U - U_P^d - \overline{U}_G. \qquad [\,6\text{-}31\,]$$

The demand for labour in the informal sector is given by $U_I^d = \beta_{X1}(V_1 / w_I)$, where $w_1$ is the product wage defined as $W_I / PV_I$. As the informal labour market always clears $(U_I^d = U_I^8)$, the product wage in equilibrium is given by

$$w_I = \beta_{X1}\frac{V_I}{U_I^8}, \text{ where } w_I = \frac{W_I}{PV_I}. \qquad [\,6\text{-}32\,]$$

As was the case with the rural supply of labour, urban unskilled labour supply, $U_U$, grows as a result of the growth of the urban population and net migration of unskilled labour from the rural economy (basically the opposite effect of the net migration from the rural areas). There is another possible reason for workers to leave the urban unskilled population: skills acquisition. Thus, a portion of the urban unskilled population acquires skills (SKL). These individuals leave the unskilled labour force to increase the supply of skilled labour in the economy. Agénor *et al* (2002) make the additional assumption that individuals are born unskilled, so that the underlying natural urban population growth is represented only by the underlying growth in the urban unskilled population, at the rate $g_U$. Thus, the size of the urban unskilled labour supply becomes larger according to:

$$U_U = U_{U,-1}(1+g_U) + MIGR - SKL \qquad [\,6\text{-}33\,]$$

The framework proposes that the growth rate of the urban unskilled population is endogenous, by taking into account several studies that document the existence of a negative relationship between the rate of population growth and income. The well-known theory of demographic transition proposes that fertility rates tend to fall as the income levels rise[23]. A particularly interesting approach is then followed by Agénor *et al* (2002), who then assume that the growth rate of the urban unskilled population is related to the distributed lag of current and past values of the ratio of average income in the urban economy for skilled and unskilled workers. If one assumes that these lags follow a declining geometric pattern and using the Koyck transformation, Agénor *et al* (2002) formulate the following relationship:

$$g_U = \lambda_g \alpha_{gu} \left[ \frac{(S_P + S_G) W_S / S}{\left[ U_I W_I + (U_P + U_G) W_M \right] / U_U} \right]^{-\gamma_{gu}} + (1 - \lambda_g) g_{U,-1,} \alpha_{gu} > 0 , \qquad [\ 6\text{-}34\ ]$$

where $\gamma_{gu} > 0$ measures the elasticity of the growth rate of the urban unskilled population with respect to the wage ratio.

How does the model deal with the acquisition of skills? The framework proposes that this is assumed to depend on three factors:

a) *The returns to education.* The authors proxy the future stream of earning associated with higher levels of education using the relative expected consumption wages of skilled to unskilled urban workers;
b) *The ability to receive education from the state.* They use the government stock of education capital, $K_E$, to proxy the ability of the ability of the individual to invest in skills; and
c) *The ability to pay for education.* This is incorporated by including the average level of wealth held by each unskilled worker, which plays an important role in the presence of liquidity constraints.

One can look at these factors in turn. First is the effect of wages. If unskilled workers acquire skills, current unskilled workers expect to earn wage $W_S$ if they are employed (with probability $\theta_S$) and nothing if they are unemployed. Once again this wage must be deflated, in this case by a skilled consumption price index, $P_{US,-1}$:

[23] Agénor *et al* (2002) quote for instance Barro and Becker (1989), and Becker, Murphy and Tamura (1990) for the growth implications of this relationship.

$$E_{ws} = \theta_S \frac{W_{S,-1}}{P_{US,-1}},$$

where $\theta_S$ is, in the same vein as above, approximated by the number of private-sector skilled workers divided by the total number of unemployed skilled workers ($\theta_S = S_{P,0} / (S_0 - S_{G,-0})$).

But if workers do not acquire skills they can naturally expect to get the average unskilled wage, which is a weighted average of the minimum wage $W_M$ and the informal wage rate. With no job turnover in the public sector, the average expected real wage is given above and repeated here for convenience:

$$E_{wU} = \frac{\theta_U W_{M,-1} + (1-\theta_U) W_{I,-1}}{P_{UU,-1}},$$

with $\theta_U$ as defined above.

Consider now the effect of initial wealth. Various studies in the endogenous growth literature[24] have proposed that the expense of acquiring skills may outweigh the impact of relative wages and the prevailing stock of government capital in infrastructure on workers' decisions. If, as the framework implicitly assumes, only firms have access to bank credit, no matter how high the wage differential is or is expected to be, unfortunately workers cannot borrow to finance human capital accumulation.[17] To incorporate the existence of these credit constraints Agénor *et al* (2002) assume that the decision to acquire skills is a function of the average level of wealth. This is derived as the sum of the wealth of informal and formal urban households divided by the number of workers, $(WT_{U1} + WT_{UF}) / U_U$.

[24] Agénor *et al* (2002) mention De Gregorio (1996).
[17] This assumption is well supported by the evidence on the composition of bank credit in low-income countries, which suggests that only a small fraction of bank loans is allocated to households (Agénor *et al* 2002). The situation is somewhat different in South Africa, with mortgage loans a substantial portion of overall credit. This type of financing can, however, only be accessed by those that can afford to buy new homes and overall, the poorer sections of the population have limited scope to raise credit.

This allows one to derive the flow of skill acquisition as being:

$$SKL = s\left[\left(\frac{WT_{UI,-1} + WT_{UF,-1}}{U_{U,-1}}\right)^{\alpha edu} {}_{K_e}\left(\frac{E_{WS}}{E_{WU}}\right)^{\sigma w}\left(K_{E,-1}\right)^{\sigma_E}\right] + (1-\lambda s)SKL_{-1,} \quad [\,6\text{-}35\,]$$

where $0 < \lambda_S < 1,_{Ke}$ is a shift parameter, and $\alpha_{edu} > 0$. To simplify matters, treat as constant the cost of acquiring skills. This can be measured by taking the number of years of schooling multiplied by the average cost of education per year.

### 6.4. (e) Urban Skilled Wages and Employment

Finally, one can consider the wage-setting behaviour for skilled labour. This is assumed to be based on efficiency considerations, such as those discussed in section 3.4. The assumption is that in order to provide incentives for employees to work and avoid shirking, firms must set a sufficiently high (product) wage rate. Agénor *et al* (2002) assume that the level of effort skilled workers provide depends negatively on the ratio of their real opportunity cost.

## 6.5. Conclusion

This chapter served to extend the discussion on how labour markets function. It provided three different approaches to considering the labour market within the context of the broader macroeconomy. The first approach took a standard neoclassical view, although the presence of some nominal rigidities was incorporated, more specifically the fact that wages are notoriously sticky downwards.

The second approach did not diverge much from the first in terms of how the macroeconomy functions. The key difference was to consider how wages are determined in the presence of insiders and outsiders. A wage determination framework was proposed where wages are set both by market forces (for the outsiders) and by institutional forces (for the insiders). This provides a key insight into how an economy characterised by powerful distortionary institutions (such as trade unions) functions. If the labour market is distorted, other markets are necessarily subject to a knock-on effect. This can create a situation in which the entire economy functions sub-optimally.

The final approach proposed that developing economies are intrisically different to developed ones and have their own characteristics, such as a segmented economy, where there is a rural economy made up of tradable and non-tradable sectors and an urban economy made up of a formal and informal economy. This creates a new level of complexity, particularly when one considers how the different 'segments' interact with one another.

Overall, the literature surveyed in this chapter builds on the earlier themes that were identified. In particular, it has been shown that the neoclassical and structuralist schools are not competing paradigms, but rather can be combined to offer a more nuanced and accurate way of representing the functioning of an economy.

The next chapter considers some recent South African empirical work on the labour market.

# Chapter 7: Recent Macroeconometric Labour Market Studies

*Thus it is not surprising that the younger economists... seem by now quite content with situations in which they can demonstrate their prowess ... [by] devising more and more sophisticated methods of statistical inference without ever engaging in empirical research*

W Leontief (1971)

## 7.1. Introduction

The focus of the thesis has so far been mainly theoretical. The major thrust has been to consider how the labour market functions in theoretical terms. Given that a large portion of the theory has been discussed, the focus of the thesis now turns to the empirical literature.

Some of the major recent studies on the theme of labour and wages are presented below. The objective of this part of the thesis is to analyse the topic from a macroeconomic viewpoint and as such the studies presented below are exclusively macroeconometric studies. Unfortunately this may exclude some excellent microeconometric studies on labour demand, e.g. Kingdon and Knight (1999), or studies that focus less on econometrics and more on interpreting patterns in labour demand, e.g. Bhorat and Hodge (1999) or Stryker *et al* (2001).

Each of the studies use a broadly similar theoretical base, in line with all of the theoretical studies in chapter 6 and the literature reviewed in chapter 2. Essentially a production function is used, rearranged to have the level of employment as dependent on the level of output and relative factor prices. The level of output relates to shifts of the demand for labour curve and relative factor prices relate to shifts along the curve. Some of the studies below consider structural factors in wage determination (in particular Fallon and Lucas 1998, in section 7.3), whereas others do not (e.g. Fedderke and Mariotti 2002, reviewed in section 7.6).

## 7.2. Fallon (1992)

The World Bank supported research by Peter Fallon (1992). Although some of the results have been criticised (by, for example, Standing *et al* 1996), both this paper and its successor (Fallon and Lucas 1998, discussed below) were particularly influential.

It is one of the earliest attempts at a rigorous analysis of the South African labour market from a macroeconometric point of view.

Fallon (1992: 32) considers the behaviour of wage rates and labour/capital employment levels over the period 1960 to 1990. As is common practice, government and domestic service employment levels are treated as given, and are thus excluded from the analysis.

In the absence of disaggregation by skill level, Fallon uses race as proxy for level of skill. In light of vast disparities in education level by race over the period 1960-1990 (see, for example, Van der Berg 2000), the proxy is a useful one, although somewhat of a simplification[25].

The categorisation is as follows:

U – unskilled, as measured by the level of employment amongst black South Africans;

SS – semi-skilled, as measured by the level of employment amongst coloured and Asian South Africans;

S – skilled, as measured by the level of employment amongst white South Africans.

Consequently, the money wage rates are defined as being $W_U$, $W_{SS}$ and $W_S$.

To simplify even further, Fallon aggregates U and SS to form a single constant elasticity of substitution category, N (non-skilled). This is formally defined as:

$$N = [\alpha U^{\theta 1} + (1-\alpha) SS^{\theta 1}]^{1/\theta 1}$$

The parameters of this aggregate are estimated from the relative marginal productivity relationship:

$$\log\left(U/SS\right) = \sigma_1 \log\left(\alpha/(1-\alpha)\right) - \sigma_1 \log\left(W_U/W_{SS}\right) \qquad [7\text{-}1]$$

[25] It is possibly problematic that Fallon (1992) combines Asians and Coloureds into one skill group

where the elasticity of substitution, $\sigma_1 = 1/(1 - \theta_1)$. The wage rate corresponding to $N$ may be written as:

$$W_N = \frac{W_U + W_{SS}}{N}$$

To model further the factor demand side of the economy, one must specify the underlying production relationship. Although he does not report the results, Fallon finds that labour demand equations derived from a Cobb-Douglas production function yielded results that were not theoretically viable[26], though statistically significant, values for relevant parameters. He thus abandoned this approach. Further, he suggests that the most general function, a translog, proves unattractive because it cannot deal with dynamic processes within this type of framework. In addition, he experimented with alternative two-level CES production functions in an attempt to see which worked best. Given three factors of production, $Z_1$, $Z_2$ and $Z_3$, this type of function may be written as:

$$Q = A(\gamma(\beta Z_1^{\theta 2} + (1-\beta)Z_2^{\theta 2})^{\theta 3/\theta 2} + (1-\gamma)Z_3^{\theta 3})^{1/\theta 3}$$

where $K$ is capital stock exclusive of government and residential property and $A$ is an efficiency parameter. In this example, $Z_1$ and $Z_2$ are contained in a single CES aggregate that is in turn nested within a further CES function. There are three possible specifications depending upon whether $Z_1$ (as above), $Z_2$ or $Z_3$ is the "odd man out". Initial experimentation with the relevant factor demand equations indicated that the most promising specification in the South African context was[27]:

$$Y = A(\gamma(\beta K^{\theta 2} + (1-\beta)N^{\theta 2})^{\theta 3/\theta 2} + \gamma S^{\theta 3})^{1/\theta 3}$$

[26] This contrasts with the findings of the other studies reviewed in this section, which find similar elasticities to Fallon using a Cobb-Douglas production function. In addition, as noted earlier, Du Toit and De Wet (2002) have proposed that the Cobb-Douglas is superior to the CES in the South African context.

[27] *Suggested interpretation*: Output ($Q$) is determined through a production function which involves capital ($K$) and labour ($N$) multiplied by an efficiency parameter ($A$). This production function is simply

This allows Fallon (1992: 39) to construct factor demand equations in stages. The relative demand for *K* and *N* is given by:

$$\log\left(K/N\right) = \sigma_2 \log\left(\beta/(1-\beta)\right) - \sigma_2 \log\left(R/W_N\right)$$

where the elasticity of substitution between *K* and *N*, $\sigma_2 = 1/(1-\theta_2)$ and *R* is the real user cost of capital.

The CES aggregate of *K* and *N* is constructed as:

$$Q = (\beta K^{\theta 2} + (1-\beta)N^{\theta 2})^{1/\theta 2}$$

The corresponding rental price of *K* is given by:

$$R_Q = \frac{R.K + \frac{W_N}{P}N}{Q}$$

where *P* is the non-government GDP deflator. $W_N/P$ is thus the real product wage of *N*.

Fallon (1992: 39) constructs the next factor demand equation in a similar way. The relative demand equation for *Q* (value added) and *S* (skilled labour) is:

$$\log\left(Q/S\right) = \sigma_3 \log\left(\gamma/1-\gamma\right) - \sigma_3 \log\left(R_Q/W_S\right) \qquad [\text{7-2}]$$

This can be used in the construction of the two-level CES production function described above. The function exclusive of the efficiency parameter is:

$$YE = \{\gamma[\beta K^{\theta 2} + (1-\beta)N^{\theta 2}]^{\theta 3/\theta 2} + (1-\gamma)S^{\theta 3}\}^{1/\theta 3}$$

The efficiency parameter can be estimated as:

$$A = Y/YE$$

---

a constant elasticity function (**total** elasticity of ($\theta_3/\theta_2$) and **individual** elasticity of $\theta_2$). The weight

Fallon (1992: 40) then estimates wages in a straightforward manner:

$$W/_{CPI} = W(Z) \qquad [7\text{-}3]$$

where the real wage is calculated as the nominal wage (*W*) over the consumption price index[28] (CPI). This is equal to the nominal wage multiplied by a vector of macroeconomic disturbances (*Z*).

given to capital is $\beta$ and the weight given to labour is $(\beta - 1)$.

[28] The use of the CPI rather than the PPI is an interesting choice, which Fallon (1992) does not explain.

## 7.3. Fallon and Lucas (1998)

A labour market study by Fallon and Lucas (1998) extended and updated the results of Fallon (1992). The study is particularly useful in that it contains both time-series and cross-sectional analyses.

### 7.3. (a) Pooled cross-industry time-series regressions

The study uses different specification to explain wage behaviour. Overall, the log of real consumption wages in eighteen manufacturing sub-sectors is regressed on either all or some of the following independent variables:

- The fraction of the population group that is not employed;
- An apartheid index, measured as prosecutions of Africans under apartheid laws per head of the African labour force;
- The fraction of employees in the sub-sector that are union members;
- The log of the one-year lagged minimum wage set by an Industrial Council. This is equal to labourer's minimum wage in the case of black South Africans and the artisans wage for other racial groups;
- A time trend;
- The lagged value of the log of real consumption wages; and
- Unanticipated inflation. This is calculated as the residual from a Box-Jenkins autoregressive technique.

In approaching the wage model, Fallon and Lucas (1998) thus go beyond the neo-classical reliance on only wages, output and relative factor prices. The introduction of the structural elements in the South African economy (such as the degree of unionisation) provides a way of broadening the scope of their enquiry.

### 7.3. (b) Labour demand equation

The authors choose a constant elasticity of substitution (CES) production function (refer to section 2.3). The CES production function used is of the form:

$$q = \eta\left[\alpha_N N^{-\rho} + \alpha_S S^{-\rho} + \alpha_K K^{-\rho}\right]^{1/\rho} \qquad [\,7\text{-}4\,]$$

$$\text{with } \eta > 0;\ \alpha_N + \alpha_S + \alpha_K = 1$$

where $N$ and $S$ indicate numbers of black and white employees respectively, $K$ is the amount of capital and the parameter $\eta > 0$. If $\rho = 0$, the CES function becomes the well-known Cobb-Douglas production function.

The first order conditions with respect to black South Africans may then be written as:

$$\ln(N) = \lambda_N \left[ \vartheta_N + \varpi \ln\left(\frac{w_N}{p}\right) + \gamma \ln(q) + \tau_N t \right] + [1 - \lambda_N] \ln(N)_{-1} \qquad [\text{ 7-5 }]$$

and for white South Africans as:

$$\ln(S) = \lambda_S \left[ \vartheta_S + \varpi \ln\left(\frac{w_S}{p}\right) + \gamma \ln(q) + \tau_S t \right] + [1 - \lambda_S] \ln(S)_{-1} \qquad [\text{ 7-6 }]$$

where $w$ indicates the respective nominal earnings for the two groups, $p$ is the producer price, $q$ is the value added, $t$ is the time in years, $\vartheta_N$ and $\vartheta_S$ are constant terms, $\varpi$ is the wage and $\gamma$ is the price elasticity. It is important to note that these are common to both equations. The sub-script –1 indicates a lag of one year. It should be noted that the introduction of the lagged term in the above first conditions is due to the assumption of a partial adjustment model in which labour adjusts imperfectly over time. In a static model, the lagged term would be absent.

Using thirty-three annual observations stretching from 1961 to 1993, Fallon and Lucas (1998) estimate the two first order conditions jointly using non-linear three-stage least squares for mining, construction and services as well as eighteen manufacturing sub-sectors.

The implied wage elasticities of demand for black South African workers are also calculated. Fallon and Lucas (1998: A2) obtain these through a formula derived from the three-equation model (production function plus two first order equations). The production function was calibrated for this purpose by deriving the estimates of $\rho$ and $\sigma$ by the regression estimates $\varpi$ and $\gamma$. $\sigma$ is the elasticity of substitution[29]. The

[29] Recall from section 2.3 that $\sigma = \dfrac{1}{1+\rho}$

distribution parameters (the $\alpha$ terms) were approximated by the factor shares in value-added in the last year of observation. The efficiency parameter, $\eta$, is derived as a residual.

### 7.3. (c) Results

This section presents some of the results in Fallon and Lucas (1998), focussing on the regressions that are most pertinent for this thesis.

**Table 7-1:** Pooled cross-industry time-series regressions – Fallon and Lucas (1998)

*Dependent variable: Log real consumption wage*

| | Black workers | | | White workers | | Other workers | |
|---|---|---|---|---|---|---|---|
| Intercept | -1.8 | 0.485 | 1.376 | -11.8 | 0.581 | -8.36 | 0.718 |
| | (5.62) | (4.99) | (7.91) | (5.67) | (2.84) | (5.40) | (3.74) |
| Unanticipated inflation | -0.346 | -0.268 | -0.420 | 0.046 | -0.059 | -0.139 | -0.171 |
| | (4.08) | (3.10) | (5.19) | (0.53) | (0.68) | (1.35) | (1.61) |
| Unemployment | -0.603 | -0.077 | -0.083 | -1.42 | -0.102 | -0.380 | -0.322 |
| | (5.03) | (1.01) | (0.62) | (5.23) | (0.52) | (5.18) | (4.45) |
| Apartheid index | -0.094 | -0.072 | - | 0.182 | 0.085 | 0.056 | -0.82 |
| | (2.80) | (2.25) | | (6.47) | (2.97) | (1.55) | (2.48) |
| Union membership (%) | - | - | 0.045 | - | - | - | - |
| | | | (2.03) | | | | |
| Year of observation | 0.006 | - | - | 0.007 | - | 0.005 | - |
| | (5.84) | | | (5.78) | | (5.73) | |
| Lagged dependent | 0.871 | 0.936 | 0.798 | 0.760 | 0.929 | 0.824 | 0.910 |
| | (45.0) | (58.4) | (26.4) | (18.0) | (39.0) | (25.7) | (34.3) |
| Industry dummy | 17 | 17 | 17 | 17 | 17 | 17 | 17 |
| No observations | 594 | 294 | 324 | 594 | 594 | 594 | 594 |
| Durbin H | -0.14 | -0.66 | 1.39 | - | 0.75 | 0.20 | -0.48 |
| Adjusted $R^2$ | 0.97 | 0.97 | 0.97 | 0.92 | 0.92 | 0.95 | 0.95 |

Source: *Fallon and Lucas (1998: A4)*

The results are theoretically consistent and show that wages are a function of unanticipated inflation, unemployment and an index for apartheid. Regression 3 for black South African workers shows that union membership is a significant determinant of wages. A one percent increase in the number of unionised workers leads to a 4,5 per cent rise in the real wage, *ceteris paribus*. Also notable is that in all regressions the lagged dependent term is significant and nearly one. This shows the extent of wage hysterisis present. This is unsurprising, considering that workers who are relatively powerful will be able to bargain for real wages higher than what they had received in the previous period.

**Table 7-2**: Long-run wage elasticities for black employees – Fallon and Lucas (1998)

| Sector | Calculated wage elasticity |
|---|---|
| Beverages | -0.184 |
| Tobacco | -0.057 |
| Textiles | -0.984 |
| Wearing apparel | -2.508 |
| Wood products | -0.196 |
| Furniture | -0.364 |
| Chemicals | -1.166 |
| Rubber and plastic | -0.243 |
| Non-met minerals | -2.929 |
| Basic metals | -0.758 |
| Fabricated metals | -0.466 |
| Non-elec machinery | -0.632 |
| Transport equipment | -0.440 |
| Mining | -0.146 |
| Construction | -0.554 |
| Services | -0.948 |
| Weighted mean | -0.709 |

*Source*: *Fallon and Lucas (1998: A9)*
*Capital stock exogenous, white labour input endogenous*

The weighted mean reported in this table (-0.709) is widely regarded as the 'benchmark' wage elasticity, particularly as it compares favourably with elasticities calculated in a number of other studies, in particular Bowles and Heintz for the Presidential Commission (RSA 1996) and Fields *et al* (2000). Yet what is often not reported in the labour market debate is that the weighted mean hides a large amount of variation. The most sensitive sub-sector is non-metallic minerals, with a wage elasticity of –2,929. The least sensitive is tobacco, where the wage elasticity is calculated as –0,057. This is particularly important, given the context of rising real wages experienced during the 1990s. Clearly, different sectors would have been affected differently: some would not have lost as many workers as others. Ostensibly this would create a shift in the demand for labour from some sectors into others, a point raised by Bhorat (2003).

## 7.4. Fields, Leibbrandt and Wakeford (2000)

### 7.4. (a) Background

Fields *et al* (2000) were commissioned by the then Department of Finance to calculate key labour market elasticities. They estimate three key relationships: the wage elasticity, the real wage/productivity relationship and the wage inflation/price inflation relationship. For the purposes of this thesis, only the wage elasticity relationship will be discussed as it impacts directly on the demand for labour.

In their model, the demand for labour is a function of three sets of factors (Fields *et al* 2000: 1):

1. The *wage*, which entails a movement along the curve. Theory suggests that an increase in the wage reduces the quantity of labour demanded along a downward-sloping labour demand curve. Thus, a negative relationship is expected.
2. The *user cost of capital*, which entails a shift of the labour demand curve. An increase in the user cost of capital could shift the labour demand curve in either direction, because of offsetting cross-substitution and cross-scale effects.
3. The *level of output*, which also entails a shift of the curve. This would be expected to be a rightward shift, i.e. a positive relationship between the level of output and the demand for labour is expected.

### 7.4. (b) Estimating equation

Fields *et al* (2000) begin by considering a standard specification, similar to the one developed in section 2.4. This suggests a labour-demand equation of the form:

$$l = \beta_0 + \beta_1 w + \beta_2 r + \beta_3 q + \varepsilon \qquad [\,7\text{-}7\,]$$

where $l$ is the demand for labour, $w$ is the real wage rate, $r$ is the user cost of capital, $q$ is output and $\varepsilon$ is a random error term. Small letters denote natural logs. The expected signs of the elasticities (the $\beta$ terms) are negative for wages, ambiguous for user cost of capital and positive for output.

### 7.4. (c) Econometric methodology

Due to their short sample (1994 to 1997, i.e. sixteen data points) Fields *et al* (2000) make an argument for using very basic econometric techniques, and do not employ any co-integration analysis, citing the poor power and size properties of standard co-integration test in finite samples (Fields *et al* 2000: 90). The short sample period and the lack of rigorous co-integration methodology, does open the paper to question. One particularly interesting finding (borne out by Wakeford (2003) and the regressions in this thesis) is that Fields *et al* (2000: 69) 'the unemployment rate plays a negligible role in nominal wage setting in this country'

### 7.4. (d) Results

The results reported here are those for the 1994 to 1998 sample.

**Table 7-3**: Empirical results - Fields *et al* (2000) for employment

| **Dependent variable: *Log*(Employment)** | **Estimated coefficient** |
|---|---|
| Constant | -3.64 (2.45) |
| *Log*(Real wages) | -0.53** (0.04) |
| *Log*(Real user cost of capital) | $-5.51 \times 10^{-5}$ (0.01) |
| *Log*(Output) | 0.83** (0.32) |
| AR(1) | 0.985** (0.32) |
| Adjusted $R^2$ | 0.99 |
| Durbin-Watson statistic | 1.57 |

*Source: Fields* et al: *Table 1.6*
*** Statistically significant at the 5 per cent level*
*Standard errors in parenthesis*

**Table 7-4**: Empirical results - Fields *et al* (2000) for wages

| **Dependent variable:** *Log(***Real product wage)** | **Estimated coefficient** |
|---|---|
| Constant | 0.82 |
| Log(Productivity) | 0.86 (0.09) |
| AR(1) | 0.41 (-0.12) |
| Adjusted $R^2$ | 0.95 |
| Durbin-Watson | 1.89 |

*Source: Fields* et al: *Table 2.8*
*Standard errors in parenthesis*

The empirical results indicate that a one per cent increase in real wages will lead to a fall of approximately 0,53 per cent in employment, *ceteris paribus*. Similarly, an increase of one per cent in output will cause a rise in employment of approximately 0,83 per cent.

In Fields *et al* (2000), the authors experiment with a number of different approaches to wages, but ultimately seem to consider a strongly neoclassical approach, where real wages are determined solely by productivity. In their estimation, a one per cent increase in productivity will lead to a 0,86 per cent increase in the real product wage. The autoregressive term evidently captures hysterisis, although it appears to be used in this estimation to solve an autocorrelation problem, which may be capturing omitted variables or poor specification.

## 7.5. Fedderke and Mariotti (2002)

Fedderke and Mariotti (2002) use panel data estimation techniques to investigate the nature of wage elasticities as well as the impact of trade liberalisation on employment in the manufacturing sector. They follow Hamermesh (1993) and allow employment to be determined by the real wage, the real user cost of capital and output.

They derive a labour demand equation of the same form as Fields *et al* (2000), as follows:

$$l = \beta_0 + \beta_1 w + \beta_2 r + \beta_3 q + \varepsilon \qquad [7\text{-}8]$$

where $l$ is the demand for labour, $w$ is the real wage rate, $r$ is the user cost of capital, $q$ is output and $\varepsilon$ is a random error term. Small letters denote natural logs. The difference between Fields *et al* (2000) and Fedderke and Mariotti (2002) is that the latter use dynamic heterogenous panel estimation methods.

Fedderke and Mariotti (2002) use a Pesaran, Shin and Smith unrestricted error correction ARDL(p,q) representation on which their panel analysis is based, of the form:

$$\Delta y_{it} = \phi_1 y_{i,t-1} + \beta_1' x_{i,t-1} + \sum_{j=1}^{p-1} \lambda \Delta y_{ij} + \sum_{j=0} \delta_{ij}' \Delta x_{i,i-j} + \mu + \varepsilon \qquad [\,7\text{-}9\,]$$

where $i = 1,2, ..., N$, stand for the cross-section units, and $t = 1,2, ..., T$ indicate time periods. Here $y_{it}$ is a scalar dependent variable, $x_{it}$ is the vector of (weakly exogenous) explanatory variables (regressors) for group $i$, $\mu_i$ represent the fixed effects, $\phi_i$ is a scalar coefficient on the lagged dependent variable, $\beta_i$'s is the $k$ x 1 vector of coefficients on explanatory variables, $\lambda_{ij}$'s are scalar coefficients on lagged first-differences of dependent variables, and $\delta_{ij}$'s are $k$ x 1 coefficient vectors on first-difference of explanatory variables and their lagged values. The assumption is that the disturbances ($\varepsilon_{it}$) are independently distributed across $i$ and $t$. The error terms also are assumed to have zero means and a constant variance. A further assumption is that $T$ is sufficiently large such to ensure that the model can be estimated for each group separately.

The advantage of a dynamic panel, particularly in the South African context, is that Fedderke and Mariotti (2002) can 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. In the case of this paper, they use a data from 28 different manufacturing sectors at the three-digit level. When constructing a user cost of capital series, they assume two different rates of depreciation: 5 per cent and 10 per cent.

Their empirical results are summarised in Table 7-5.

**Table 7-5**: Empirical results – Fedderke and Mariotti (2002)

| | *5 per cent depreciation* | *10 per cent depreciation* |
|---|---|---|
| Long-run coefficients | | |
| Wages | - 0,502* (0.074) | - 0,552* (0.126) |
| Cost of capital | - 0,011* (0.001) | - 0,008* (0.001) |
| Output | 0,857* (0.068) | 1,002* (0.118) |
| Speed of Adjustment | - 0,206 (0.046) | -0,147 (0.028) |

This shows that a rise in real wages leads to a fall in employment, irrespective of the depreciation rate that is assumed. A rise in the cost of capital also has a negative effect on employment. Output has a strong and positive effect on the level of employment.

Assuming a capital depreciation rate of five per cent, a one percent rise in real wages is estimated to lead to a 0,5 per cent fall in employment. A one per cent rise in the cost of capital will also lead to a fall in employment of approximately 0,01 per cent. A rise in manufacturing output stimulates employment generation, with a one per cent rise leading to in the level of employment of almost 0,9 per cent. The speed of adjustment is 0,206, indicating that it takes nearly 5 years for the changes in the explanatory variables to affect the level of employment.

If one were to assume a higher rate of depreciation, of 10 per cent, the results are broadly similar, with a one per cent rise in wages and the cost of capital leading to a fall of 0,6 per cent and 0,008 per cent in the level of employment respectively. A similar increase in the level of output would lead to a rise in employment of one per cent.

Overall, the results of Fedderke and Mariotti (2002) are consistent with the theoretical priors of chapter 2 and with both Fallon studies. The authors, however, take a standard neoclassical approach and do not control for structural effects, such as unionisation. This is unfortunate as their panel approach is particularly powerful for an investigation into the effects of unionisation as the manufacturing sub-sectors are characterised by a range of different unions with different degrees of power and influence.

## 7.6. Du Toit and Koekemoer (2003)

### 7.6. (a) Methodology

Du Toit and Koekemoer (2003) use a supply-side neoclassical macroeconomic model for the modelling of employment in South Africa. Their approach is based on the work of Layard and Nickell, who have become known for using supply-side modelling techniques (see, for example, Layard and Nickell 1986).

The focus of their work is to test the hypothesis that South Africa is experiencing jobless growth. Although the frame of reference is narrow, their modelling technique allows room for analysing a number of related issues.

For empirical purposes, the authors divide the South African labour market into two parts: a skilled and an unskilled labour market. The distinction is based on differences in the wage determination processes and differences in the demand for skilled and unskilled labour. This may be the result of different levels of productivity and the role of labour unions.

The econometric methodology used for long-run relationships is the Engle-Yoo three-step procedure. This procedure is a residual-based co-integration technique, The three-step is basically the same approach as the two-step discussed in more detail in section 8.2 below, except that in the final stage the standard errors of the coefficients are adjusted.

### 7.6. (b) The theoretical framework

*d. The labour market*

The theoretical framework uses a labour demand equation, a labour supply equation and a wage adjustment equation (Du Toit and Koekemoer 2003: 3). The framework can be distinguished from other frameworks in that it incorporates market imperfections, such as imperfect competition in the goods markets and the role of unions in wage setting. The framework also acknowledges the existence of an equilibrium rate of unemployment[30].

The demand for labour is specified as:

$$N_t^d = f(w_t^p, Z_t^d) \qquad [\,7\text{-}10\,]$$

where $w_p$ is the real wage rate defined in terms of production prices and $Z^d$ is a set of exogenous variables affecting the demand for labour. These might include the real prices of other factors of production, the capital stock, and output.

Labour supply is defined in a similar way:

$$N_t^s = f(w_t^c, Z_t^s) \qquad [\,7\text{-}11\,]$$

where $w^c$ is the real wage rate in terms of consumer prices and $Z^s$ is a set of exogenous determinants of labour supply such as the potential labour force, unemployment benefits and real interest rates.

Under market-clearing conditions, the real wage rate ($w^*$) is obtained by solving the demand and supply equations, i.e. by setting demand equal to supply.

$$w^* = f(T, Z^d, Z^s) \qquad [\,7\text{-}12\,]$$

where $T$ is a set of tax variables causing a wedge between the real product wage and the real consumption wage[31].

Market-clearing employment ($N^*$) is given by:

[30] Often referred to as the non-accelerating inflation rate of unemployment, NAIRU.

$$N^* = f(T, Z^d, Z^s) \qquad [7\text{-}13]$$

In a framework that allows for disequilibrium, actual employment is typically determined as the minimum of demand and supply ($N = \min(N_t^s - N_t^s)$). A wage adjustment mechanism could be specified as:

$$w_t - w_{t-1} = f[(N_t^s - N_t^d), Z_t^w] \qquad [7\text{-}14]$$

where $Z_t^w$ is a vector of factors causing wages to deviate from their equilibrium values.

A reduced-form equation for the non-market-clearing model is[32]:

$$w_t = f(Z_t^s, Z_t^d, Z_t^w, T, w_{t-1}) \qquad [7\text{-}15]$$

The labour force (*L*) may be treated as exogenous or explained by a participation equation. Both instances allow changes in employment to be directly associated with changes in unemployment:

$$U_t = L_t - N_t \qquad [7\text{-}16]$$

In practice, the excess supply of labour is proxied by the level of unemployment (*U*), giving:

$$w_t - w_{t-1} = f(U_t, Z_t^w) \qquad [7\text{-}17]$$

This closely resembles the augmented Phillips curve:

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[31] Du Toit and Koekemoer appear to ignore the problem that another wedge exists, that of the difference in deflator. The demand for labour (real product) wage is deflated by the production price index (PPI) and the supply for labour (real consumption) wage is deflated by the consumer price index.

[32] The non-market-clearing model thus only differs from the market clearing model in that lagged wages ($w_{t-1}$) and $Z^w$ are included. In essence, this model suggests that wages are a function of a set of demand factors, supply factors, taxes and also the lagged wages and factors 'causing wages to deviate from equilibrium values' (Du Toit and Koekemoer 2003).

$$w_t - w_{t-1} = f(U_t, P_t^e \mid_{P_{t-1}}, Z_t^w) \qquad [\text{7-18}]$$

where $P^e$ is the expected price level. The Phillips curve, i.e. the relationship between inflation and unemployment, is therefore embodied in the dynamic adjustment mechanism to equilibrium[33].

*e. The demand for labour*

For the purposes of consistency between factors demands and price setting, Du Toit and Koekemoer (*ibid.*: 4) suggest that these equations and every decision about the supply of output ought to be derived jointly. They quote Nickell (1988), who suggests that if this consistency is not present, the equilibrium level of employment consistent with the NAIRU may not correspond with that given by the labour demand function conditioned on equilibrium real wages. Following earlier work by Du Toit (1999), a straightforward production-function approach is utilised to model the demand for labour.

Assume a production function of the general form:

$$y = y(n, k, t) \qquad [\text{7-19}]$$

where $y$ is output, $n$ is employment, $k$ is capital stock and $t$ is technology. The labour demand function can be derived by rearranging the marginal productivity condition for labour under profit maximisation. A firm ensures profit maximisation by employing workers up to the point where the real wage equals the marginal product of labour.

$$w/p = y_n(n, k, t) \qquad [\text{7-20}]$$

Rearranging and substituting capital with the production function yields:

$$n^d = n^d(w/p, y, t) \qquad [\text{7-21}]$$

[33] The existence of the Phillips curve remains one of the great controversies of modern macroeconomics. It is unfortunate that Du Toit and Koekemoer do not provide a rigorous justification for including it as part of the dynamic adjustment mechanism. The Phillips curve is briefly discussed in section 4.8 of this thesis.

Assuming Cobb-Douglas technology then gives:

$$n^d = \alpha . y(W/p)^{-1} \qquad [\ 7\text{-}22\ ]$$

with $\alpha$ the labour elasticity of production.

*f. Labour supply*

In order to derive a consistent model for unemployment, the supply of labour is specified as:

$$N_t^s = EAP_t * LFP_t \qquad [\ 7\text{-}23\ ]$$

where *EAP* is the economically active population[34]. *LFP* represents the labour force participation rate.

The rate of labour force participation is defined as:

$$LFP_t = f(w_t^c, Z_t^s) \qquad [\ 7\text{-}24\ ]$$

where $w^c$ is the real wage rate defined in terms of consumer prices, and $Z^s$ is a set of exogenous determinants of labour supply, such as unemployment benefits, the role of labour unions and real interest rates.

*g. Wage determination*

Du Toit and Koekemoer (*op cit.*) close the model with a sub-model for wage determination, also formulated in the supply-side tradition.

Nickell (*op cit.*) suggests that a wage function has to be sufficiently general to encompass every possible mechanism of wage determination, including:

(i) Supply and demand factors;

(ii) Firms' profit-maximising and cost-minimising behaviour;

(iii) The role of unions;

[34] Defined in this case as that portion of the population that is both eligible to work and between the ages of 15 and 65.

(iv) The process of collective bargaining.

The Du Toit-Koekemoer approach is one based on a union-bargaining framework and assumes imperfect competition in goods markets. The framework is extended to incorporate the role of taxes that create a wedge between the real product wage and the real consumption wage.

Firms are assumed to bargain over wages in order to maximise their expected profits, given as $\pi^*$:

$$\pi_i^* = \frac{P_i}{P^e} Y_i - \frac{W}{P^e} N_i \qquad [\,7\text{-}25\,]$$

where $P_i$ is the mark-up price the firm sets, $P^e$ is the expected aggregate production price level, $Y_t$ is the firm's output, $W$ is the nominal wage and $N_i$ the labour demanded by the firm.

Expected real profits can be written as a function with the form:

$$\pi_i^* = \pi_i\left(\underset{-}{W/P^e}, \underset{+}{Y/\alpha L}\right)K_i \qquad [\,7\text{-}26\,]$$

where $Y^*$ denotes expected demand and $K_i$ capital stock.

A union, representing the labour force associated with a certain firm ($L_t$), is assumed to bargain over wages in order to maximise its utility ($U_t$):

$$U_t = N_i v + (L_i - N_i)\bar{v} \qquad [\,7\text{-}27\,]$$

where $v$ is a union member's utility if he is employed within the firm, $\bar{v}$ is his utility if not. The union member's utility function may be written as:

$$v = v\left(W_c / P_c^e\right) \qquad [\,7\text{-}28\,]$$

and

$$\bar{v} = \bar{v}(W_c / P_c^e, N/L, z_2) \qquad [\,7\text{-}29\,]$$

where $W_c$ is the consumption after-tax wage and $P_c^e$ is expected consumer prices, denoting $W_c/P_c^e$ as the real consumption after-tax wage. The variable that improve the worker's welfare while unemployed are given as $z_2$. These may be the replacement ratio or unemployment benefits.

The real consumption wage is dependent on the real product wage and the wedge between the two. This wedge may consist out of:

(i) Taxes changing product wage relative to consumption wage (e.g. employer's labour taxes, employees' income taxes and taxes on consumption goods; and

(ii) The real price of imports, $P_m/P$.

The above equations can therefore be re-written as:

$$\bar{v} = \bar{v}\left(W/P, z_1, P_m/\overline{P}, z_2, N/L\right) \qquad [\ 7\text{-}30\ ]$$

where $z_1$ is the taxation element of the wedge.

Since employment ($N_i$) can be written as a function of the form:

$$N_i = N_i\left(W/P^e, Y^*/\alpha L\right)K_i \qquad [\ 7\text{-}31\ ]$$

the union's utility function can be written as:

$$U_i = (v - \bar{v})N_i(W/P^e, Y/\alpha L)K_i + \bar{v}L_i \qquad [\ 7\text{-}32\ ]$$

The wage function, resulting from a union-firm wage bargaining model in the tradition of Nash is of the form:

$$W/P = w\left(\underset{+}{Y^*/\alpha L}, \underset{+}{N/L}, \underset{+}{z_1}, \underset{+}{z_2}, \underset{+}{P_M/\overline{P}}\right) \qquad [\ 7\text{-}33\ ]$$

Nickell[35] (1985) suggests that the exogenous and endogenous elements should be separated. Hence, $P_M/P$ becomes $\left(\frac{P_M}{P*}\right)\left(\frac{P*}{\overline{P}}\right)$, where the first term is the exogenous terms of trade and the second term is the endogenous level of competitiveness. Including a measure of union power ($U_P$), which is positively related to real wages, the wage equation can finally be written as:

$$\frac{W}{P} = w\left(\frac{Y*}{\alpha L}, \frac{N}{L}, \frac{P*}{\overline{P}}, z\right)\frac{P^e}{P} \qquad [\ 7\text{-}34\ ]$$

### 7.6. (c) Empirical results

Du Toit and Koekemoer (2003) have the following empirical results:

**Table 7-6**: Empirical results – Du Toit and Koekemoer (2003)

| | *Skilled Labour* | *Unskilled Labour* |
|---|---|---|
| **Short-run coefficients** | | |
| Skilled wages | -0.39<br>(-5.93) | N/a |
| Unskilled wages | 0.38<br>(5.30) | N/a |
| Output | 0.48 | N/a |
| International position index | -0.04<br>(-2.96) | N/a |
| Socio-economic index | N/a | -0.27<br>(-3.42) |
| Nominal unskilled wage bill | - | 0.11<br>(1.77) |
| **Constant** | 0.0053 | -0.0214 |
| *Speed of adjustment* | -0.43<br>(-2.24) | 0.40<br>(-3.09) |
| *Calculated long-run elasticities* | | |
| Skilled wages | -0.198 | 0.000 |
| Unskilled wages | 0.219 | -0.056 |
| Output | 0.224 | 0.344 |
| Dummy 1994 onwards | -0.017 | 0.000 |
| Dummy 1999 and 2000 | -0.022 | 0.000 |

*Sourced: Du Toit and Koekemoer (2003)*
*Parenthesis indicate t-statistics*

It is clear that Du Toit and Koekemoer (2003) consider the theoretical framework carefully. The empirical results are, however, somewhat different to those found in all

[35] Quoted in Du Toit and Koekemoer (2003)

the other studies reviewed in this section. The calculated long-run wage elasticity of employment of -0,198 for skilled labour and -0,056 for unskilled labour differs significantly from the much higher wage elasticities calculated by the other authors (and by the present author in section 10.2a). Unfortunately, the authors do not compare their work with the other work and have not justified the different coefficients. In addition of an 'affirmative action dummy' for 1994 is somewhat confusing. There is a strong case for a structural break occurring in 1994, but a number of new policies were implemented then, including the acceleration of the liberalisation of tariffs and the rationalisation of the civil service, both of which could plausibly also explain the negative coefficient on this dummy. Indeed, employment equity legislation was only formally passed in the late 1990s.

Theory does not suggest that the nominal wage bill should affect the level of unskilled wages, as indicated by Table 7-4.

Overall, the paper is included here for two reasons: firstly, it provides an excellent theoretical approach and secondly it implicitly contradicts the findings of other researchers, providing a different perspective.

## 7.7. Wakeford (2003)

Wakeford (2003) builds on Fields *et al* (2000). The paper is a far more rigorous version of the latter, particularly as it does take into account the co-integration properties of the data. In it, the author considers the relationship between labour productivity (as measured by output per worker), real wages and unemployment. He sets out to test the 'highly complex' inter-relationships between the three variables. Theoretically, there are a number of possible causal relationships between these variables. The possibilities are presented in Table 7-7.

**Table 7-7**: Hypothesised causal relations

| Causal direction | Expected sign | Rationale |
|---|---|---|
| PROD → RW | + | Performance-based pay; bargaining. |
| PROD → UR | + | Greater efficiency implies reduced labour demand |
| | - | Positive output effect on unemployment |
| RW → PROD | + | Efficiency wages |
| RW → UR | + | Higher labour costs causes factor substitution |
| UR → RW | - | Surplus labour weakens union bargaining power |
| UR → PROD | + | Workers increase effort to secure jobs; |
| | | Less productive workers are fired first |

*Source: Wakeford (2003: Table 1)*

The paper also considers the presence of structural breaks, which are crucial for ensuring that the econometric results can be interpreted correctly.

Wakeford (2003) uses a number of econometric and statistical techniques to consider these relationships.

- Graphical presentation of the variables to see how the variables change over time.
- Tests for non-stationarity, to get a better sense of how the variables behave over time.
- Statistical tests of the variables, e.g. correlation co-efficients and Granger causality tests.

- Multivariate tests (Johansen) for co-integration, which allows the researcher to test for statistically significant long-run relationships between the variables.
- Computing the long-run elasticities using a co-integration framework, in his case the vector-error correction method.

The paper makes two important findings for the purposes of the present research.

Firstly, Wakeford (2003) finds evidence of a structural break in the first quarter of 1990. After 1990, he finds evidence of a significant change in key variables such as real wages, productivity and employment. He puts forward a number of reasons for this structural break:

- A severe, sustained recession during the early 1990s. This recession was due to the unfortunate combination of a drought, economic sanctions, a global economic downturn and uncertainty as political transition became inevitable.
- The rise in real interest rates after Dr Chris Stals became governor of the central bank in 1989, which may have stifled economic activity and consequently job creation.
- Increased factor substitution of capital and high-skilled workers for low-skilled labour, driven by the rapid rise in technology in the early 1990s and the increasing integration of the South African economy with the rest of the world (also raised by Fedderke and Mariotti 2002).
- Increased labour market intervention by government (see also Barker 1999 and chapter 2).

The second important finding is that the unemployment rate is a not significant determinant of real wages (Wakeford 2003: 14). This is in contrast to the findings of Fallon and Lucas (1998), which are reported in Table 7-1 of this thesis. This may indicate that the labour market is relatively rigid, as unemployment does not act as a brake on real wage growth. Alternatively, it may indicate the presence of a 'dual-labour market'. Skilled, unionised workers are powerful enough and in short supply giving them the ability to bid up wages irrespective of the effect on unemployment (see discussion on insider-outsider models in section 2.5 above).

In terms of empirical findings, Wakeford (2003: 15) finds a co-integrating relationship between the log of real wages and the log of output per worker. This means that there is an underlying long-run relationship between the two variables. The econometric tests can be used to determine whether or not there is a causal relationship between the variables. The results of the VECM estimated by Wakeford (2003) are presented in Table 7-8.

**Table 7-8**: Empirical results – Wakeford (2003)

| Error correction models | | |
|---|---|---|
| 1990Q1 – 2002Q4; *n = 52* | *Dependent variable* | |
| *Regressor* | $\Delta Log$(Real wages) | $\Delta Log$(Labour productivity) |
| **Dynamics** | | |
| Constant | 0.72 * (2.52) | -0.21 * (-2.22) |
| $\Delta Log$(Real wages$_{t-1}$) | -0.14 (-0.85) | -0.14 * (-2.65) |
| $\Delta Log$(Labour productivity$_{t-1}$) | 0.34 (0.84) | 0.24 (-1.77) |
| Error correction $_{t-1}$ | -0.37 * (-2.50) | 0.11 * (2.30) |
| R-squared | 0.19 | 0.20 |
| Adjusted R-squared | 0.14 | 0.15 |
| F(3, 48) | 3.87 | 3.92 |

*Source: Wakeford (2003: Table 11)*

Overall, Wakeford (2003: 16) summarises the results as indicating that:

- Real wages have a negative impact on productivity – this is indicated by both a Granger causality test and a statistically significant relationship, as shown by Table 7-8;
- Productivity has no effect on real wages – indicated by the lack of both Granger causality and statistical insignificance;
- Productivity has a weak autoregressive pattern; and
- Adjustment to equilibrium occurs through both wages (negatively) and productivity (positively).

## 7.8. Conclusion

This chapter reviewed a number of different approaches to modelling the South African labour market. Broadly speaking, each model began from a neoclassical base and introduced market imperfections. These market imperfections included:

- A segmented labour market, where the labour force is broadly classified into skilled, semi-skilled and unskilled components;
- Imperfect competition, wage setting institutions and union power;
- Dualistic (urban v rural) factor markets.

The elasticities estimated by the literature reviewed above are summarised in Table 7-9.

**Table 7-9**: 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*

The literature provides a good base from which to analyse the inter-relationships between employment on the one hand and productivity and wages on the other. Overall the findings suggest that rising real wages lead to falling employment. The rise in real wages may be as result of neoclassical reasons, such as productivity. Alternatively, they may also be as a result of structural factors, such as unionisation or an inefficient labour market. The review of the literature above also indicates that there is a recent trend toward considering the functioning of the labour market at a macroeconomic level, at trend that this thesis follows. The next chapter introduces the empirical part of the thesis by outlining the methodology that will be used.

# Part III

## Empirical Analysis

# Chapter 8: Methodology

*Do not confuse the word [econometrics] with 'econo-mystics' or with 'economic-tricks', nor yet with 'icon-metrics'...That the subject is exceedingly complicated does not entail that it is hopeless.*
*David Hendry (1980)*

## 8.1. Introduction

The focus now moves to the empirical analysis, the final dimension of the labour market that is considered in this thesis. This chapter digresses briefly from the underlying theme of the demand for labour to discuss the econometric methodology used in this, the empirical part of the paper. The chapter considers some of the methodological issues involved with time-series analysis and with the use of large structural models.

The first issue that is discussed is the problem of non-stationarity in time-series economic data. This is followed by a discussion of three different methodologies that are used in the presence of non-stationary data, namely the Engle-Granger two-step, the single-equation error-correction method (ECM) and the vector error correction method (VECM).

## 8.2. Single equation frameworks

### 8.2. (a) The problem of non-stationarity

Before a behavioural equation or system of equations can be estimated, it is necessary to consider the underlying process generating the data. It is possible to show that a model containing 'non-stationary' variables will often lead to a problem of spurious regression. As a result, the results obtained suggest that there is a statistically significant relationship even though this putative relationship may only be evidence of some or other contemporaneous correlation, and not reflect a meaningful casual relationship (Harris 1995: 14).

Non-stationarity can be considered in terms of the first two moments of a time series, and in this case a series is defined as non-stationary if:

- The mean is increasing or decreasing with time;
- There is non-constant variance;
- There is non-constant covariance.

To demonstrate this problem, consider a very simple data generating process. The dependent variable $y$ is generated by the following process:

$$y_t = \rho y_{t-1} + u_t$$

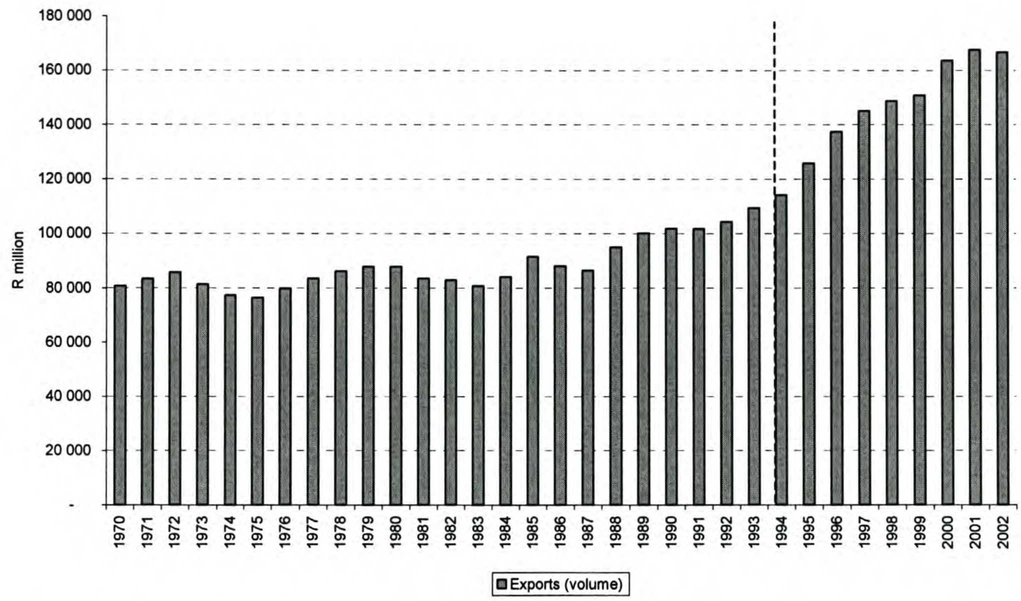
This is a first-order autoregressive process and the current values of the variable $y$ depend on the last period's value ($y_{t-1}$) plus a disturbance term $u_t$. The variable $y$ is stationary if $|\rho| < 1$. If, however, $\rho = 1$, then $y$ will be non-stationary.

### 8.2. (b) Causes of non-stationarity

Hendry and Juselius (1999) note that the problem of non-stationarity was identified as early as 1926 by a statistician, Uzdy Yule. Yule identified 'nonsense regressions' and argued that these regressions were nonsense because the variables shared a common trend. Thus it may appear that there is a statistical relationship between two variables, when in reality they are merely moving together. This may lead to 'forecast failure', a situation where it is impossible to forecast the future movement of economic variables on the basis of their past performance. Given this problem, Hendry and Juselius (1999) note that forecasting is far more accurate with non-stationary variables than with stationary variables.

Non-stationarity may also occur for other reasons – for example, legislative change may mean that a series exhibits structural breaks (Hendry and Juselius 1999: 3). Figure 8-1 shows the level of real exports from South Africa and it is clear that the series behaves differently before and after 1994. The reason can be directly ascribed to the end of sanctions against South African trade. This series clearly does not have a constant mean over the period 1980 – 2002. This is merely an example used to demonstrate intuitively how a series with a structural break may be non-stationary.

**Figure 8-1**: Legislative change and non-stationarity: volume of exports




Structural breaks such as these can be modelled using a technique such as specifying dummy variables for periods when there is good reason to suspect that economic time series may behave differently[36].

The problem of non-stationarity is, however, of particular concern when it is as a result of the persistent accumulation of past effects. This is known as a 'unit-root process' (Hendry and Juselius 1999: 3). It is possible to identify a number of plausible reasons why particularly economic data may contain these trends. Technological progress, for example, implies precisely this 'persistent accumulation': The body of technical knowledge is continually added to as new inventions and discoveries occur.

The process of accumulating technical knowledge is a good example of a unit-root process for another reason. Knowledge is not accumulated smoothly, but rather accumulates in fits and starts. There is thus a 'jumpy' trend and not a linear one. Such

[36] For example, between the period 1985 to approximately 1992, when South Africa was economically isolated due to sanctions.

processes can be interpreted as allowing a different 'trend' at every point, or a stochastic trend.

Hendry and Juselius (1999: 4) explain this in a somewhat more rigorous way. Consider the following simple regression containing a fixed ('deterministic') trend:

$$y_y = y_0 + \beta_t + u_t \text{ for } t = 1, \ldots\ldots T \qquad [\,8\text{-}1\,]$$

Hendry and Juselius then propose that one can even make the example more realistic by suggesting that the error term $u_t$ is allowed to be autoregressive – i.e. each successive error is related to the one before it. One can specify a first-order autoregressive process:

$$u_t = \rho u_{t-1} + \varepsilon_t \qquad [\,8\text{-}2\,]$$

That is, the current value of the variable $u_t$ is affected by its value in the immediately preceding period ($u_{t-1}$) with a coefficient, $\rho$, and a stochastic shock $\varepsilon_t$. The stochastic shock has all the usual specifications regarding normality and constant variance.

### 8.2. (c) The Engle-Granger two-step procedure

The problem of non-stationarity can be overcome by transforming a non-stationary series into a stationary series. The Box-Jenkins approach is to take differences (see Enders 1995). Unfortunately, as noted by Charemza and Deadman (1999), information regarding the relationships between the levels of time series may be lost. In a seminal paper Engle and Granger (1987) developed a two-stage method. This method has become known as the 'Engel-Granger two-step procedure'. For this contribution (and some others) to time series econometrics Robert Engle and Clive Granger received the 2003 Nobel Memorial Prize in Economic Sciences.

The first step is to specify a long-run relationship. If the residual series of this behavioural equation is stationary, then there is a co-integrating relationship between the variables. In the presence of co-integration, the problem of non-stationarity does not lead to spurious regressions.

The long-run equilibrium relationship is specified in the following form:

$$y_t = \psi_0 + \psi_1 x_1 + \varepsilon_t \qquad [\ 8\text{-}3\ ]$$

where $\psi_0$ and $\psi_1$ are the sample regression coefficients and ε is the unexplained variation, or error term.

The short-run relationship is then specified using the differences of the time series. The functional form is as follows:

$$\Delta y_t = \beta_0 + \beta_1 \Delta x_t - (1-\alpha)(y_{t-1} - \beta_1 - \beta_2 x_{t-1}) + u_t \qquad [\ 8\text{-}4\ ]$$

where α and β are the short-run co-efficients and $u_t$ is the short-run error term.

8.2. (d) Advantages and disadvantages of the Engle-Granger approach

A single equation framework provides a relatively simple approach to analysing the interaction of time-series variables. On a more formal note, Fedderke (2003a: 161) suggests that where there is a unique cointegrating vector, the Engle-Granger procedure allows the researcher to use the superconsistency property of ordinary least squares to obtain consistent estimates of the cointegrating vector.

In addition, since the Engle-Granger procedure can be combined with a second stage of estimating short-run dynamics, it provides useful information about the speed of adjustment to equilibrium.

The procedure does, however, have some critical limitations. These are discussed by Enders (1995: 385) and include:

- The estimation of the long-run equilibrium regression requires that one variable is the dependent variable and the others the regressors;
- In the presence of short samples, as is the case with most econometric series, the Engle-Granger becomes less robust;

- In practice the procedure generates different results for cointegration depending on the ordering of the variables;
- The method has no systematic procedure for the separate estimation of the multiple cointegrating vectors; and
- As the procedure is undertaken in two steps, any errors committed by the researcher in the first step are carried over to the second.

### 8.2. (e) Single-equation error-correction method (ECM) approach

In practice, the two-step method proves to be time-consuming. A single-equation, error-correction has thus become popular in a wide variety of applied work (e.g. Wesso 2001 and Aron, Muellbauer and Smit 2003). Also known as the Engle-Granger 'one-step' method, the ECM can be seen as a 'short-cut' version of the two-step.

It specifies the function to be:

$$\Delta y_t = \beta_0 + \beta_1 \Delta x_t - (1-\alpha) y_{t-1} + \beta_2 (1-\alpha) x_{t-1} + u_t \qquad [\text{ 8-5 }]$$

It must be borne in mind, however, that one of the assumptions of the one-step method is that it assumes there is a single co-integrating relationship between the variables and that the explanatory variables are weakly endogenous.

### 8.2. (f) The ARDL approach

Fedderke (2003a: 197) considers the Pesaran-Shin-Smith autogressive distributed lag (or ARDL) approach to estimating single equation estimation of cointegrated relationships. Similarly to Engle-Granger methodology, the approach requires that the long-run relationship is unique.

Suppose the question is whether there exists a long-run relationship between three variables, $y_t$, $x_{1t}$, $x_{2t}$. The univariate time-series characteristics of the data are not known. In this approach, the error-correction model is given by (Fedderke 2003a: 198):

$$\Delta y_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \sum_{i=0}^{p} \gamma_{1i} \Delta x_{1,t-i} + \sum_{i=0}^{p} \gamma_{2i} \Delta x_{2,t-i} + (\delta_1 y_{t-1} + \delta_2 x_{1,t-1} + \delta_3 x_{2,t-1}) + \varepsilon_t \qquad [\text{ 8-6 }]$$

Essentially the ARDL is thus an extension of the single-equation ECM set out above. It differs in one important respect, that additional lags of each variable are added to get a system that has more of an auto-regressive nature than that of the ECM.

To test for the presence of a long-run relationship, the standard F-statistic for the joint significance of:

$$\delta_1 = \delta_2 = \delta_3 = 0 \qquad [\,8\text{-}7\,]$$

is computed.

The distribution of the test statistic is non-standard and Fedderke (2003a: Table 8A and 8B) reports the relevant critical values as calculated by Pesaran, Shin and Smith (1996). The reported critical values of these tests then allow the researcher to determine whether or not there is a long-run relationship present between the variables.

## 8.3. Multiple equation frameworks

So far the analysis has considered single equation approaches to time series analysis. The focus now moves to consider two multiple equation frameworks, the Johansen vector-error correction and the structural macroeconomic model approach.

### 8.3. (a) Vector-error correction framework

Sims (1980) criticised much of macroeconomic modelling on the basis of the fact that in macroeconomic systems, many variables are likely to be interdependent. He proposed the use of vector autoregressive systems (VARs). In these systems, each variable is regressed on lagged values of all the other variables in the system, including itself (Fedderke 2003a: 208). The VAR is a wholly statistical approach and does not impose strong *a priori* restrictions on any particular structural relation, nor on the exogeneity of variables.

The weakness of the VAR approach is its over-reliance on statistical techniques (see, for example, Pagan 2003). The VECM methodology provides the researcher with a more structured and economically tractable approach to undertaking econometric research.

The methodology can be summarised as follows (as in, for example, MacDonald and Ricci 2003: 19):

The vector $x_t$ consists of a set of regressors with a VAR representation assumed to be of the form:

$$x_t = \eta + \sum_{i=1}^{p} \Pi_i x_{t-i} + \varepsilon_t \qquad [\,8\text{-}8\,]$$

where $\eta$ is an ($n$ x 1) vector of deterministic variables, $\varepsilon$ is an ($n$ x 1) vector of white noise disturbances, with mean zero and a covariance matrix $\Theta$ and $\Pi_i$ is an ($n$ x $n$) matrix of coefficients. The above expression may be reparameterised into a vector error correction mechanism (VECM) as:

$$\Delta x_t = \eta + \sum_{i=1}^{p-1} \Phi_i \Delta x_{t-1} + \varepsilon_t \qquad [\,8\text{-}9\,]$$

where $\Phi_i$ is a ($n$ x $n$) matrix of coefficients (equal to $-\sum_{j=i+1}^{p} \Pi$), $\Pi$ is a ($n$ x $n$) matrix (equal to $\sum_{i=1}^{p} \Pi_i - I$) whose rank determines the number of cointegrating vectors.

Whether or not there is cointegration can be tested by considering the rank of $\Pi$:

- If $\Pi$ is of either full rank, $n$, or zero rank, $\Pi = 0$, no co-integrating relationship exists amongst the elements in the long-run relationship. In these instances it is appropriate to estimate the model in levels or first differences respectively.
- If $\Pi$ is of reduced rank $r$, where $r < n$, then there exist ($n$ x $r$) matrices $\alpha$ and $\beta$ such that $\Pi = \alpha\beta'$, where $\beta$ is the matrix whose columns are the linearly independent co-integrating vectors. On the other hand, $\alpha$ is known as the adjustment matrix and gives an indication of the speed with which the system responds to deviations from the cointegrating relationships.

There are a number of ways of testing for the number of cointegrating relationships ($r$), including considering the trace test statistic and or the likelihood ratio statistic. Most econometric packages, including the one used in this thesis (Eviews), report a series of statistics that allow the researcher to evaluate the number of cointegrating relationships.

### 8.3. (b) Structural model

A structural macroeconomic model is generally a system of equations and identities, econometrically estimated and underpinned by theory (Clements and Hendry 1998). Given the strong theoretical base of most structural models they are widely used to implement theoretical frameworks such as those discussed in chapter 6. Internationally, structural models are particularly popular for policy analysis and typically provide a good balance between theory and practical applied econometrics (Pagan 2003).

This class of model has, however, suffered from two important criticisms. The first is that of Sims (1980), who suggested that macroeconomic models impose 'incredible restrictions'. The second is the Lucas critique where changes in policy may induce changes in the behaviour of economic agents, or in his own words

> Given that the structure of an econometric model consists of optimal decision rules for economic agents, and that optimal decision rules vary systematically with changes in the structure of series relevant to the decision maker, it follows that any change in policy will systematically alter the structure of econometric models
>
> Lucas (1976: 41, quoted in Hendry 2000)

The approach can best be explained by considering the examples of smaller structural models of Aron and Muellbauer (in, for example, Aron and Muellbauer 2000a, 2000b and Aron, Muellbauer and Smit 2003). The Aron-Muellbauer approach informed much of the estimation of the National Treasury model that is used in the simulations and is summarised in section 8.4 below.

The approach is set out in Aron *et al* (2003). In this paper they begin with richly parameterised equations for a range of prices and wages, comprising a wage-price-exchange rate bloc for the South African economy.

The system comprises a set of equations specified according to a single-equation equilibrium correction model of a general form similar to that discussed above, *viz.*:

$$\Delta \log Y_{j,t} = \gamma(\alpha_0 + \mu + \sum_{i=1}^{n} \alpha_i X_i - \log X_j)_{t-1} + \sum_{i=1}^{n}\sum_{s=0}^{k} \beta_{i,s} \Delta X_{i,t-s} + \sum\sum \theta_{i,s} \mid \Delta X_{i,t-s} \mid + \sum_{s=1}^{l} \lambda_{j,s} \Delta \log X_{j,t-s} + \varepsilon_t$$

[ 8-10 ]

where the $X_i$ variables are determinants for $Y_j$ and $\varepsilon_t$ is white noise.

Clements and Hendry (1998) provide an excellent discussion of a number of the issues around the use of structural models[37]. They note that there are a number of complicating factors, not least of which is that many of these models can contain up to 100 equations, specifying many different aspects and linkages in an economy. The most important drawbacks, however, can be summarised as being (Clements and Hendry 1998: 158):

- The parameters of the model may be non-constant over the forecast period, either because the process being modelled is non-constant although the model was 'correctly specified';
- Parameters may be unknown, and need to be estimated from available data;
- There maybe exogenous variables that need to be forecast 'off-line', e.g. oil prices; and
- The forecaster may have extraneous knowledge of events that will occur (e.g. strikes) which the model does not specifically take into account.

### 8.3. (c) Exogeneity

Exogeneity is a particularly important consideration when multiple equation frameworks are used. An exogenous variable is a variable that is uncorrelated with the error term (see, for example, Wooldrige 2000: 795). For the purposes of time series analysis, Engle, Hendry and Richard (1983) distinguish between three types of exogeneity, *viz.* weak, strong and super. Exogeneity is particularly important if the exogenous variable is to be used as a policy 'lever' for simulations. Essentially, simulations involve the researcher changing a particular variable (for example, wages)

[37] Some of these issues are highlighted in more detail in the discussion of how to use a model for policy simulations below.

to measure the effect on the outcome variable (for example, employment). There may be feedback from wages to output that may render the policy instrument useless[38].

To distinguish between the types of exogeneity, consider the VECM framework above. If a variable is exogenous, then there is no feedback – the independent variables are not influenced by the dependent variables. Weak exogeneity can be tested by considering the error correction term (the $\alpha$ matrix of the discussion above) is not significant determinant of the independent variable. Strong exogeneity imposes a further requirement, which is that there is no Granger causality from the dependent variable to the independent variable. Super exogeneity occurs when there is no change in the parameters of interest over different periods, or in other words that the system fully accounts for structural changes.

## 8.4. Overview of the National Treasury model

The model used for this analysis is the National Treasury Quarterly Macroeconomic Model. An extensive specification of the model and all of the equations can be found in Van Rensburg and Smit (2002). A similar quarterly model is Bank of England (2000) and an annual model in this tradition is Smit and Pellisier (1997) or Bureau of Economic Research (2001). Given that the focus of the rest of the thesis is on the labour market, the discussion here will concentrate more on the non-labour market parts of the model. Also, the discussion here will focus more on the theoretical aspects of the model and less on the empirical equations.

The model is demand-determined, with specific supply elements (Van Rensburg and Smit 2002: 4). It consists of approximately 280 variables, of which 148 are endogenous and about 20 are fitted using behavioural equations. There are eight blocs of equations. These are for

- prices;
- the monetary sector;
- employment / wage determination;
- expenditure;
- fiscal variables;

[38] This is an econometric way of expressing Heinz' (2003) criticism of Fedderke (2003) discussed in

- exchange rates;
- balance of payments / external variables; and
- calculation of GDP.

In terms of the specification of equations, the model uses an Engle-Granger single-stage error-correction co-integration approach as discussed above. This ensures that not only does the model have a long-run 'equilibrium' solution, but that it also can take into account short-run disequilibria.

As Pauly (2003) has pointed out, a structural model such as this merely estimates the parameters of an IS-LM-AD-AS open economy framework by solving for equilibrium.

Each part of the model is discussed below.

### 8.4. (a) Demand side of the model

The demand side of the model is an extension of a standard framework, such as the one in equations [6-9] to [6-17]. A framework for a typical model is set out in brief in Smit (2003), or more extensively in Pauly (2003).

The basis of the demand side is the well-known national accounts income-expenditure identity.

$$Y = C + I + G + II + X - M \qquad [\,8\text{-}11\,]$$

where $Y$ is income, $C$ consumption by households, $I$ investment, $II$ change in inventories, $X$ exports and $M$ imports.

Each of these components has a corresponding equation or equations determining it. In the *expenditure bloc*, consumption is a function of disposable income, real interest rates and wealth. Investment is a function of real output, capacity utilisation and the cost of capital, with other factors such as commodity prices also playing a role.

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chapter 4: lowering real wages may have a negative effect on output and hence on employment.

Government consumption is taken as exogenous. Change in inventories is a function of changes in demand and the real prime rate.

In the *prices bloc*, there are behavioural equations for eleven price variables. The basic price equations are for producer prices, consumer prices, the targeted CPIX measure, a household consumption deflator, a government consumption deflator, a deflator for investment goods, an export price deflator and an import price deflator. Then there are the aggregate deflators, for gross domestic expenditure and gross domestic product respectively and the terms of trade calculation. Prices are generally estimated to be a function of unit labour costs, the exchange rate and capacity utilisation.

The *monetary bloc* consists of equations for interest rates, the user cost of capital and equations for the money variables (Van Rensburg and Smit 2002: 12). The short-term interest rates are related to the repo rate, the policy rate of the South African Reserve Bank. The level of the repo is based on a Taylor-rule function, which models the monetary policy decisions of the central bank in terms of the inflation-targeting framework. Money is endogenous only insofar as private sector credit extension, which is estimated as a function of the prices of domestic expenditure, demand and interest rates. Identities specify variables for other monetary variables, e.g. the velocity of money.

A re-estimated *employment bloc* is set out in the following chapter.

The *fiscal bloc* comprises a detailed set of identities for the various components of total expenditure by general government. There are three main parts (Van Rensburg and Smit 2002: 28):

- Total expenditure is made up of consumption by government, interest paid on debt, subsidies, transfers from government and capital expenditure. In turn, government consumption is made up of wage expenditure and non-wage expenditure.
- Revenue is split into direct taxes, indirect taxes and other revenue. In turn, direct taxes are made up of both corporate and personal taxes. Indirect taxes are split up

according to the various indirect taxes raised by the government (VAT, excise duties, fuel levy and so forth).

- Savings, deficit and debt are then calculated according to the System of National Accounts definitions. Thus general government savings is the difference between general government revenue and expenditure. The fiscal deficit, on the other hand, is calculated for national government, according to the National Revenue Find definition.
- The model also allows for a number of fiscal policy reaction functions.

The *balance of payments* is made up of a set of behavioural equations for exports (exports of gold, exports of merchandise goods and exports of services) and for imports (merchandise and services). The current account is then calculated by subtracting net factor payments and adding net transfers to the trade balance. Change in net reserves is then the balancing item and is determined by the change on the current account added to net capital inflows.

The demand-side of the model is specified such that output is determined by the sum of the various expenditure components, i.e. household consumption, government consumption, investment and the trade balance.

### 8.4. (b) Supply side

The supply side of the model forms the link between capacity utilisation and the behavioural equations for prices, imports and investment. Capacity utilisation in this sense is the difference between trend and actual output. A Cobb-Douglas production function is then fitted to the trend output series.

## 8.5. Using a structural model for policy simulations

There are typically two distinct approaches to doing policy analysis with structural models (Whitley 1994: 180). The first is to use alternative forecasts for policy simulations and the second is to undertake counterfactual policy simulations.

### 8.5. (a) Policy simulations using alternative forecasts

The first approach is to do a range of forecasts given different assumptions about key variables. In essence, the process involves firstly running a baseline forecast, followed by an alternative forecast or scenario that considers the effect of a set of different assumptions.

A recent example of this approach is Bureau of Economic Research (2001). In this paper, the researchers set out to forecast the path of the economy with HIV/AIDS and compared it to a baseline forecast of No Aids. Forecasts based on different assumptions about key variables (such as the oil price or exchange rate) are also typical. Alternate forecasts are typical of the regular use of structural models for policy advice and implementation. Institutions which regular provide forecasts for policymakers (e.g. the South African Reserve Bank and the National Treasury), often provide alternative forecasts to give a better sense of how sensitive the base forecast is to different assumptions.

This approach can also include changing of policy. In this regard policy reaction functions are frequently used. Reaction functions describe a policy reaction to deviations from policy objectives (Whitley 1994: 182). An example is the Taylor rule, which models interest rate changes by the central bank as a function of changes in inflation and output. The researcher could change the policy reaction function (for example, make the central bank more sensitive to changes in the inflation rate) and then consider what the effect would be on the macroeconomy.

Forecast policy analysis does, however, have a number of shortcomings. One of these is that forecasts are not only the product of a model, but are also largely dependent on the forecaster's own judgement (Whitley 1994: 185). It is possible to have two different forecasts from one model. This usually arises when the forecasts are adjusted to 'fit' what the forecaster expects the result to be, either in his own judgement or to bring his forecast closer to those of other forecasters. For example, Whitley (1994: 185) quotes both McNees (1991) and Wallis *et al* (1984, 1985) who show that forecasts tend to show less divergence than the underlying models, suggesting that the forecasters judgement 'pushes' the forecasts towards consensus with other forecasters.

There are two types of policy simulations that could be undertaken (Whitley 1994: 200). The first type is when the policy instrument is included in model and the second is when the policy instrument is not known.

*a. Policy simulations when the policy instrument is known*

The starting point is the exposition of the linear model (Whitley 1994: 200):

$$By_t + Cz_t = u_t \qquad [\ 8\text{-}12\ ]$$

where $B$ and $C$ are parameters, $y_t$ and $z_t$ describe vectors of interest and $u_t$ is a random error term.

Equation [8-12] has the reduced form

$$y_t = \prod z_t + v_t \qquad [\ 8\text{-}13\ ]$$

where

$$\prod = -B^{-1}C$$

$$v_t = B^{-1}u_t \qquad [\ 8\text{-}14\ ]$$

and $\prod$ represents the set of policy multipliers.

In policy analysis, the researcher typically needs to start with a benchmark against which to compare the results of the policy change. The base run or control solution is given by:

$$B\hat{y} + Cz_t = 0 \qquad [\ 8\text{-}15\ ]$$

where the error term $u$ has been set equal to its mean value of zero. In essence this is an *a priori* solution of the model, before the researcher has considered changes to inherent policy rules or to exogenous assumptions. The researcher can then change the set of exogenous variables $z$ with $(z_t + \delta_t)$, the revised solution is then the following:

$$B\widetilde{y} + C(z_t + \delta_t) = 0 \qquad [\,8\text{-}16\,]$$

As a result, the effect of the policy can be calculated as $\widetilde{y}_t - \hat{y}_t$.

In this formulation, $\delta$ is a vector of policy changes (Whitley 1994: 201). The vector may vary over time or take different forms. For example, it might be assumed that government expenditure is raised by a constant amount relative to the value that it takes in the base or control solution (a step change). Alternatively it might be assumed that that the growth in government expenditure is permanently higher than in the base simulation (a growth change). The researcher can choose to consider one policy instrument change at a time, i.e. one element of $\delta$ is non-zero. Alternatively, changes in more than one instrument at a time give what Whitley (1994: 201) calls a policy scenario. In a linear model, the effect of a number of policy instruments taken together should give the same result as adding the collective result of running policy changes separately.

There is another possibility: the researcher may not necessarily want to know the effect of a changing a policy instrument, but rather wants to know the required change in a policy instrument to produce the desired change in the targeted variable. Then, given that:

$$B(\widetilde{y}_t - \hat{y}_t) + C\delta_t = 0 \qquad [\,8\text{-}17\,]$$

it is possible to solve for $\delta$ so as to find the required change in the targeted variable.

*b. The policy instrument is not known*

In some cases, the policy instrument may not be part of the model: for example, if the policy that has to be tested is new, or if the policy change is similar, but not defined by an included exogenous variable (Whitley 1994: 201).

In the first case, where there is no existing policy instrument, there are a number of options. The researcher can augment the model using a residual adjustment:

$$a_t = -C\delta_t \qquad [\ 8\text{-}18\ ]$$

The net effect will be the product of the estimated parameters of the model and the change in the residual. Whitley (1994: 202) considers the example of modelling import quotas. As a result it may be necessary to alter coefficients of the import equation. Other equations, for example investment, would not be directly altered.

Once again, it is useful to consider the example of the HIV/AIDS simulation undertaken in BER (2001). In this structural model, population was not endogenous in the consumption equations. To consider the effect of additional mortality on consumption, the modellers had to make off-model calculations of what the effect of death would be on overall household consumption, taking into account consumption by different demographic groups and how the different demographic groups would be affected by HIV/AIDS.

### 8.5. (b) Policy simulations using counterfactual modelling

So far, this chapter has considered policy simulations using forecasts. A second option is to undertake counterfactual policy analysis. In this case, one is considering how the economy might have behaved over some historical period, given a different policy (see Whitley 1994: 219). Examples of the use of counterfactual policy analysis are forecasts of economic performance under different fiscal spending assumptions (for results see National Treasury 2003: 56), analysis of the monetary transmission mechanism (see Smal and De Jager 2001) and the analysis of an optimal interest rate path (Du Plessis and Smit 2003). In the first case the National Treasury quarterly model was used; the second example used the South African Reserve Bank structural model and the final example utilised the Bureau of Economic Research structural model.

#### *a. Conducting a counterfactual exercise*

When conducting counterfactual policy analysis, the researcher typically will follow the following steps:

- Undertake a baseline or benchmark historic run. Thus the model solves in-sample, and is calibrated to ensure that the solved values correspond to the actual values, by adding the single-equation residuals back to fitted values (Whitley 1994: 219)[39].
- Change the variable of interest. As with the forecast simulation, this could involve changing an exogenous assumption or changing a policy rule.
- Re-solve the model given the new values for the variables.
- Compare the new outcome with the baseline outcome.

In the case of Smal and De Jager (2001), for example, the researchers changed the value of the policy interest rate variable. This allowed them to then trace the effect of a change on other variables, for example the rate of inflation.

*b. Defining the policy regime*

There are two different ways of going about assessing the effect of a policy (Whitley 1994: 220): the first is to consider the impact of an *alternative* policy on the economy (or on other variable); the second considers the impact of the *actual* policy on the economy. The first case is straightforward: the researcher will simply follow the same procedure as above. The second case is a bit trickier – here one has to create a 'neutral' policy stance, and compare the results of the actual policy to that of the neutral policy stance.

Comparing the effect of actual policies is particularly contentious, as has recently been highlighted by a debate between Collier and Dollar (2001) and Easterly (2003). The former proposed that government policy has made a significant difference to growth outcomes in the developed world. The latter contended that this argument was spurious – by changing some of the underlying assumptions in Collier and Dollar (2001) the opposite could be proven. Hence, no clear evidence existed that policy intervention had had any impact on growth outcomes. Which is correct? Neither researcher is able to clearly trace the counterfactual of what would have happened had the policies *not* been implemented. The result is that empirical results can be easily challenged and can be proved to be incorrect, as Easterly (2003) did.

[39] This is not strictly necessary. If the residuals are not added back, then the simulation results must

## 8.6. Conclusion

A model is merely an abstraction of reality. The discussion above highlighted that no approach can be perfect – there are advantages and disadvantages to every approach. Given that there are many feedback effects that need to be considered when analysing the question of the demand for labour, this thesis uses the structural model approach. Given the fact that a well-developed model exists which more than adequately captures many of the linkages inherent in the South African economy, it provides a useful tool with which to analyse the questions at hand. Also, as the purpose of the model is mainly to do fiscal policy analysis, there is no comprehensive treatment of the labour market. By introducing a sound, theoretically consistent employment bloc within the model, it is possible to do a range of scenarios and 'what-if' policy analyses.

compared to the fitted values (Whitley 1994: 219).

# Chapter 9: Data – Sources, Analysis and Assessment

*[Labour] data may be dirty, but in many cases it is more like mud than original sin*

*Daniel Hamermesh (1999)*

## 9.1. Introduction

This chapter considers the data used in the analysis more carefully. The chapter is structured as follows – firstly the sources of the data are discussed, including some of the problems associated with South African labour market data and some alternative sources are considered. Then the interaction of labour market variables with other macroeconomic variables is considered. Thereafter, some of the underlying statistical and econometric characteristics of the data are considered. These include tests for the presence of unit roots, pairwise correlations and Granger causality tests.

## 9.2. Sources

### 9.2. (a) Main sources of data

The data used in this thesis is sourced from the South African Reserve Bank *Quarterly Bulletin* and downloaded using an online facility hosted by Global Insight, an international data dissemination firm. Additional data, for example on the number of mandays lost, was obtained from Andrew Levy Publications, a consultancy specialising in labour market research. A detailed list of the data series used and the corresponding codes is provided in the data appendix.

### 9.2. (b) Problems with the data

Labour market data is notoriously inconsistent and problematic, not only in South Africa (for some of these problems see Klasen and Woolard 1998, Makgetla and Van Meelis 2002, Nicolau 2002 or Aliber 2003) but also internationally (see, for example, Hamermesh 1999). Some of the problems listed in this literature include:

- Unemployment is measured in a number of different ways. The narrowest of definitions is the number of people registered as unemployed at government employment agencies. By this measure, there are approximately 300 000 people out of work in South Africa. Alternatively, the official measure, which is defined as those who have sought work in the two weeks prior to the survey, estimates the number of people out of work as 4,6 million (Statistics South Africa 2002b). The expanded definition, which includes those regarded as discouraged, estimates the number of unemployed as 7,6 million.

- Capturing the informal and subsistence sectors of the economy is notoriously difficult, with recent surveys attempting to estimate the number of subsistence farmers, for example, reporting large differences from survey to survey.
- There appear to be problem with some of the more technical aspects of many of the calculations, with concern being expressed, for example, about the methodology of calculating standard errors.

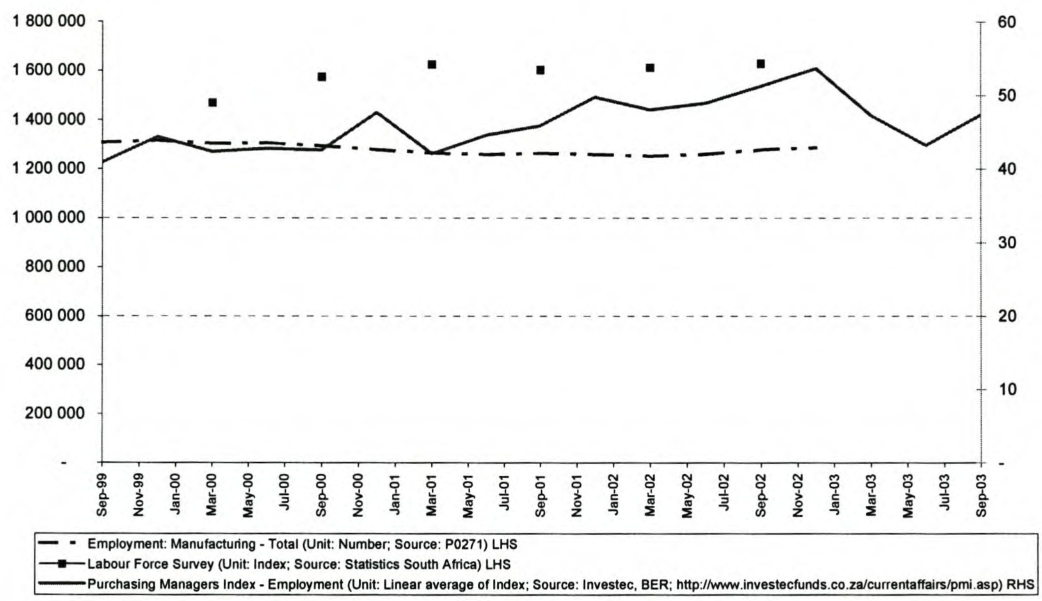
Statistics South Africa does conduct periodic reviews of labour market data and is presently engaged in a process of significantly improving data that is available. This introduces another problem: data collection is not consistent over time. Consistency is also a problem as a result of the inclusion and exclusion of the former homeland areas, which makes interpreting labour trends over time particularly difficult (see, for example, Bhorat and Hodge 1999).

### 9.2. (c) Comparing data sources

The Reserve Bank sources its time-series labour market data from the *Survey of Employment and Earnings*, a publication of Statistics South Africa (for an overview of the survey see Statistics South Africa 2002a). As is discussed in National Treasury (2004) and is shown below, this survey is notoriously problematic, but it remains the only source of time-series data.

Figure 9-1 compares three different sources of manufacturing employment data: the Investec/BER purchasing managers' index (PMI), the SARB series and a series constructed from successive the Labour Force Surveys (LFS). It is immediately apparent that the LFS reports higher employment than the SARB series – due in part to the LFS having a larger sampling frame. The PMI, on the other hand, provides monthly employment data, although by definition it does not cover the whole economy, but only the limited pool of respondents. This thesis uses the quarterly time series numbers of the SARB with the caveat that these numbers are not necessarily consistent with other sources of data.

**Figure 9-1**: Different data sources – manufacturing




## 9.3. Preliminary data analysis and findings

Before the formal econometric analysis can commence, some preliminary analysis of the data must be undertaken. This will provide useful background for the econometric work in the next chapter. Also, indications of possible findings will be identified. The discussion below presents both a sectoral and aggregate analysis of employment, output and real wages.

### 9.3. (a) Employment and output

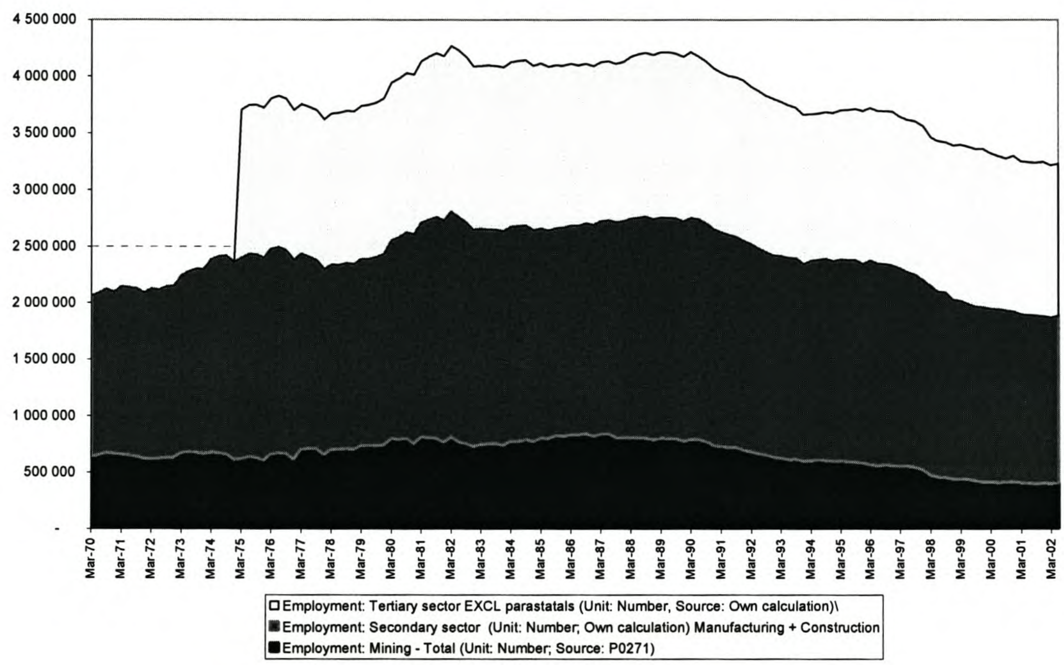
There is an extensive international literature suggesting that employment is characterised by cyclical movements (see, for example, Lilien 1982).

*a. Sectoral analysis*

Figure 9-2 presents a breakdown of employment by sector as reported by Statistics South Africa. It shows the secular decline in overall employment from 1990. According to this data set, the decline is driven by a fall in employment in the secondary sector, which employed nearly 2 million workers in the first quarter of

1990 and only 1,5 million a decade later. In the mining sector, the number of jobs halved over the period – from 800 000 to 412 000. Job creation in the tertiary sector stagnated over the period, with the number of jobs (1,4 million) virtually unchanged over the same period.

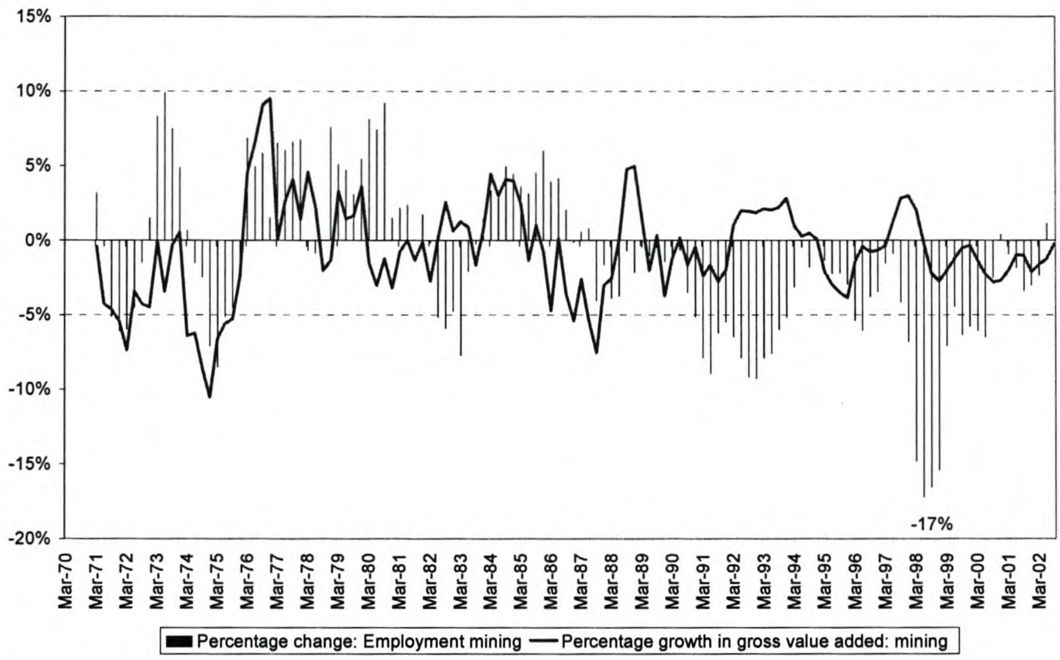
**Figure 9-2**: Employment by sector (quarterly data)*




**Values for tertiary sector employment not available before 1975*
*Source: SARB (various)*

Comparing this performance to the performance of the economy indicates that the secondary sector stands out a part of the economy that grew even while shedding jobs.

**Figure 9-3**: Gross value added and employment (y-o-y) – Mining sector




The mining sector (Figure 9-3) has been characterised by a declining share of value added as the broader economy has evolved from being resource intensive to more service intensive. In addition, changes in gross value added have been mainly negative.

**Figure 9-4**: Gross value added and employment (y-o-y) – Secondary sector

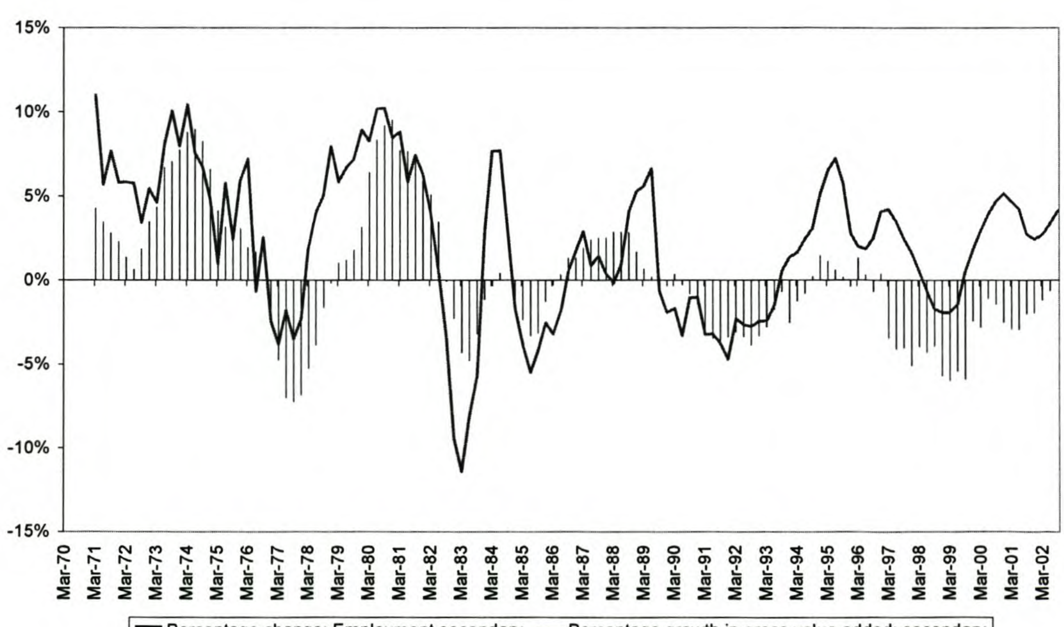
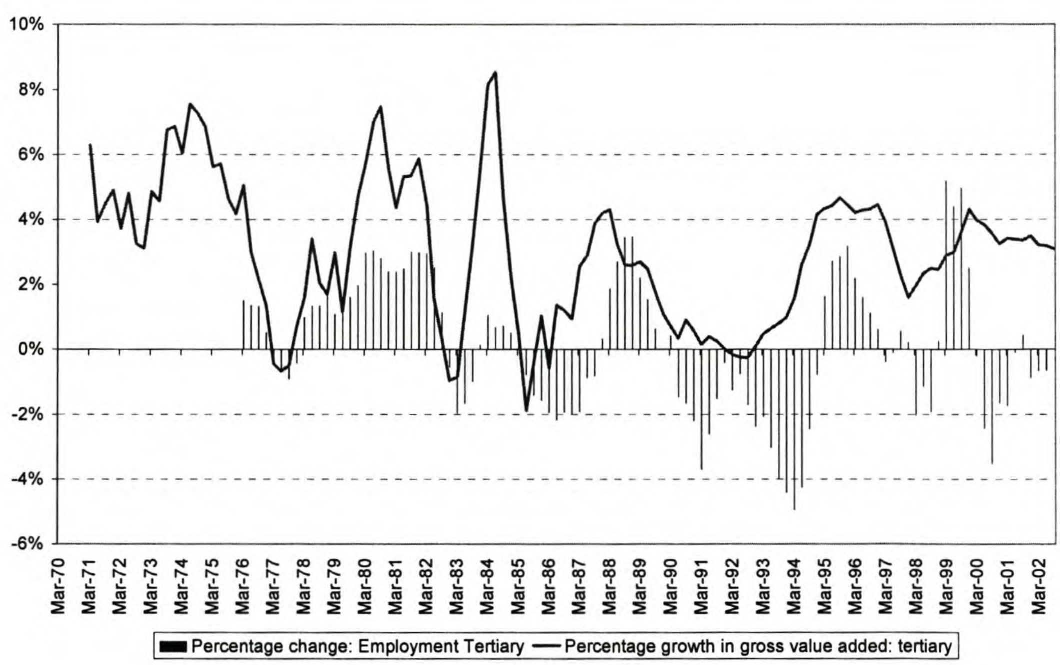


Figure 9-4 shows output in the secondary sector (manufacturing and construction). It appears particularly volatile and employment closely tracks changes in output. The upswing in activity after the Asian crisis, however, did not translate into job creation with there still being a net decline in the number of jobs created since 1998.

For the tertiary sector (Figure 9-5 on the following page), the picture is somewhat rosier. Although the sector still exhibits cyclical movements, there are few actual declines in gross value added. Similarly employment growth is positive over most of the period. The exception is the recession of 1989 to 1992. As the figure shows, the tertiary sector almost completely stagnated and had to cut significant jobs. The employment record in the latter part of the 1990s was also surprisingly poor, given the sustained and robust growth in output over the period.

**Figure 9-5**: Gross value added and employment (y-o-y) – Tertiary sector

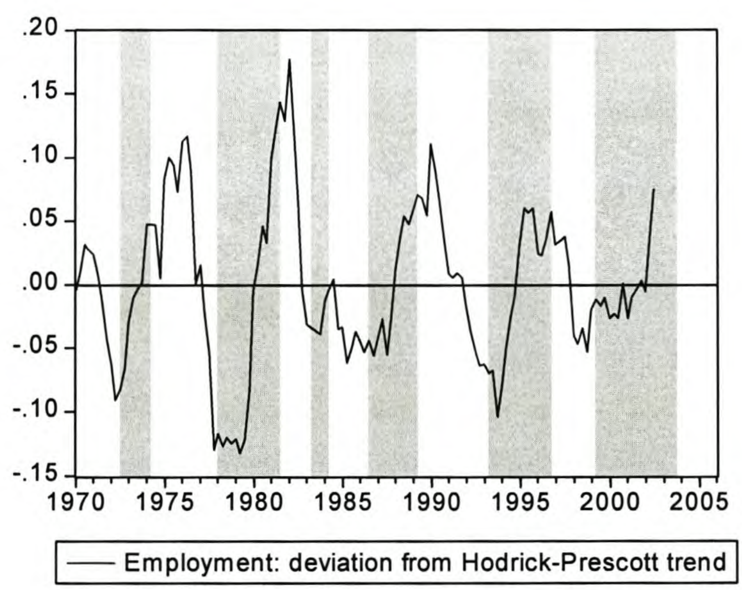



At the sectoral level there is thus evidence of a relationship between output and employment. The analysis now moves to the aggregate level.

*b. Aggregate level*

Figure 9-6 presents the relationship between total private sector employment and the business cycle in South Africa. Employment is measured as the deviation from the long-run (Hodrick-Prescott) trend. For the early part of the series, economic downswings (white bands) are clearly associated with falls in the level of employment. The falls do, however, occur a few periods after the relevant turning points. There also exists a relationship between upswings (shaded bands) and increases in employment, but this relationship gradually breaks down in the latter part of the 1990s. This is an area of concern, particularly in light evidence that upswings have shortened (see, for example, Du Plessis and Smit 2002).

**Figure 9-6**: Employment and the business cycle




*Shaded areas indicate economic upswings as defined by the South African Reserve Bank.*
*Source:* SARB *Quarterly Bulletin*, various issues

Erasmus and Weideman (1995) find that until 1994 South African employment was characterised by pro-cyclical fluctuations. They establish that, apart from 1970, the upper turning point of the employment cycle consistently lagged that of the aggregate business cycle. In the case of the lower turning points, the relationship between the aggregate business cycle and the employment cycle was somewhat less consistent. The relationship between the cycles is summarised in Table 9-1.

**Table 9-1**: Aggregate business cycle and private sector employment cycle

| Turning-point | Aggregate business cycle | Private sector employment cycle | Lag in quarters (+) Lead in quarters (-) |
|---|---|---|---|
| Upper | 1970:4 | 1970:4 | 0 |
| Lower | 1972:3 | 1972:2 | -1 |
| Upper | 1974:3 | 1975:4 | +5 |
| Lower | 1977:4 | 1978:2 | +2 |
| Upper | 1981:3 | 1982:1 | +2 |
| Lower | 1983:1 | 1983:3 | +2 |
| Upper | 1984:2 | 1984:3 | +1 |
| Lower | 1986:1 | 1985:2 | -3 |
| Upper | 1989:1 | 1989:2 | +1 |
| Lower | 1993:2 | 1994:1 | +3 |
| Upper | 1996:4 | 1995:4 | -4 |
| Lower | 1999:2 | 2000:2 | +4 |

*Source: Until 1994, Erasmus and Weideman (1995); after 1994, own calculations*

The existence of a clear employment cycle, however, becomes less certain during the latter 1990s.

**Table 9-2**: Growth in formal private sector employment

| Year: Quarter | Private sector employment growth |
|---|---|
| 2000:1 | -3.8 |
| 2000:2 | -0.7 |
| 2000:3 | -3.0 |
| 2000:4 | 2.0 |
| 2001:1 | -4.6 |
| 2001:2 | 0.3 |
| 2001:3 | -0.9 |

*Source: SARB Quarterly Bulletin, March 2002, s-152*

South Africa has experienced an economic upswing since August 1999 (SARB 2002: s-147). As Table 9-1 shows, however, the private sector has only added jobs in two quarters – the final quarter of 2000 and the second quarter of 2001. The job creation has also been quite modest in comparison to the contraction in employment experienced during the past decade.

Erasmus and Weideman (1995: 28) suggest the following reasons for the lagged relationship between business cycle upswings and employment cycle upswings:

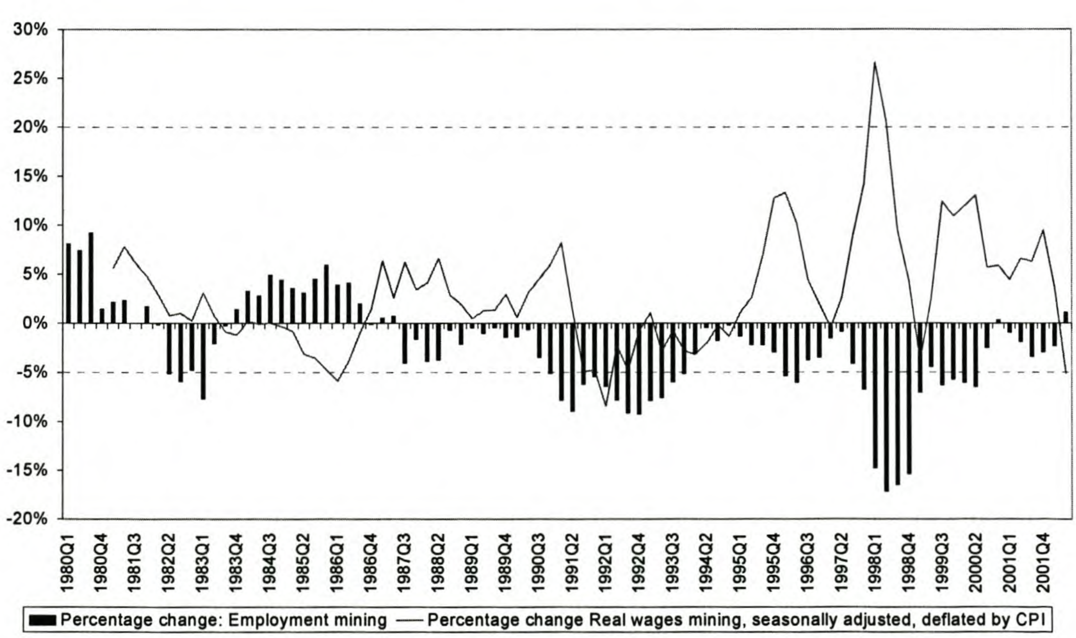
- uncertainty among employers regarding the permanence of the changes in economic activity;
- a low level of utilisation of factors of production, which allows employers to respond to increases in aggregate demand by increasing utilisation, not employment;
- costs involved in varying the size of the workforce;

### 9.3. (b) Wages and employment

*a. Sectoral analysis*

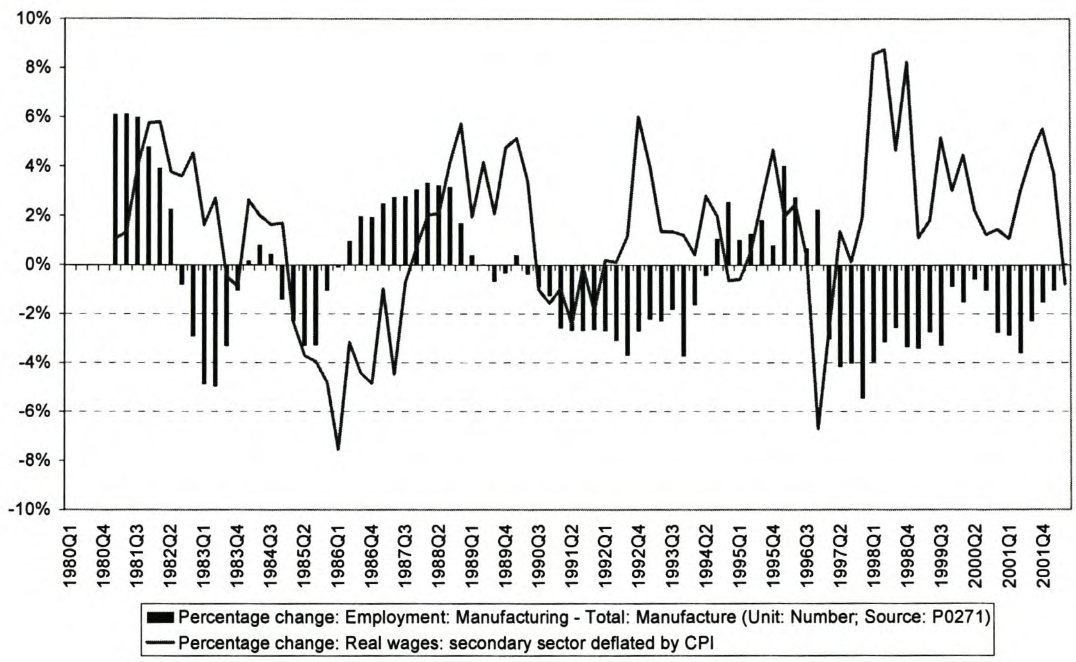
Figure 9-7 shows that real wages have been extremely volatile in the mining sector. Periods of high wage growth, in particular 1998, were characterised by falls in employment.

**Figure 9-7**: Wages and employment (y-o-y) - Mining sector



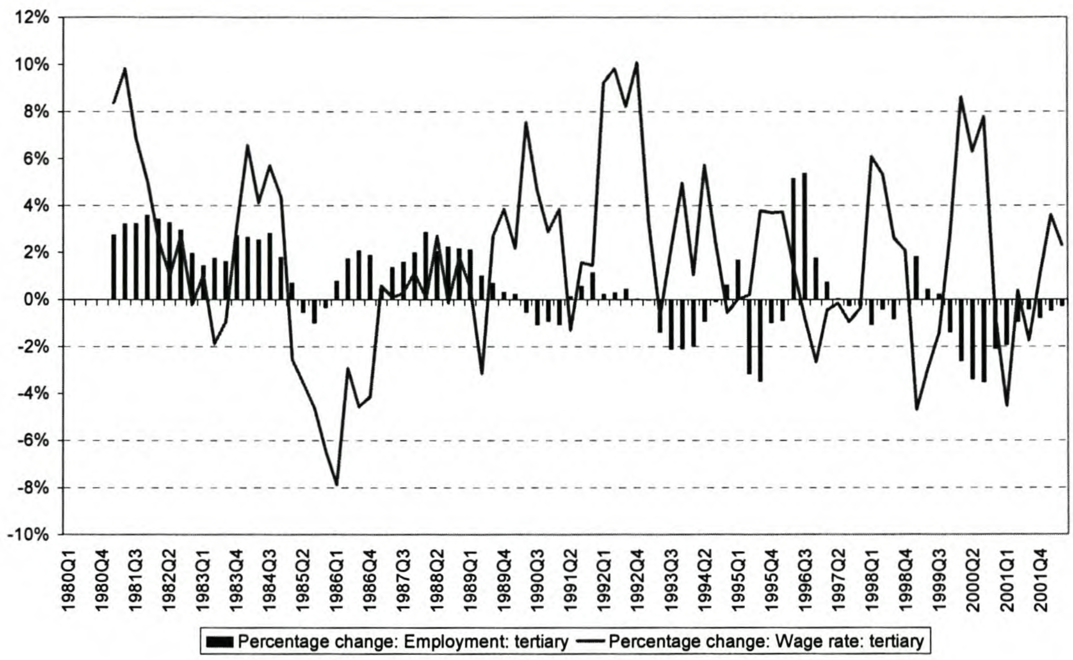
In manufacturing the relationship between wages and employment is not as clear (see Figure 9-8) until after 1997, when high real wage growth was associated with job shedding.

**Figure 9-8**: Wages and employment (y-o-y) – Manufacturing sector




In the tertiary sector the relationship is less strong, with real wage growth particularly volatile over the period. During periods of high real wage growth (e.g. 2000) there is evidence of job shedding.

**Figure 9-9**: Wages and employment (y-o-y) – Tertiary sector




*b. Aggregate level*

The aggregate level comparison is presented in Figure 9-10. It shows that there is a negative relationship between real wages and employment, with periods of particularly high real wage growth (such as 1998) leading to marked declines in employment creation. Given that 1998 was also the only year since the democratic elections where gross value added contracted (cf. Figure 9-6), it is not surprising that it was the worst year for job-creation, with the official statistics recording a loss of 150 000 jobs.

### 9.3. (c) Union power and wages

Another factor that will be considered in the empirical equations is how union power affects wages. A preliminary assessment is presented in Figure 9-11. There is some evidence of wages growth being associated with rises in union activity, but this relationship is not clear.

**Figure 9-10**: Aggregate level real wages and employment

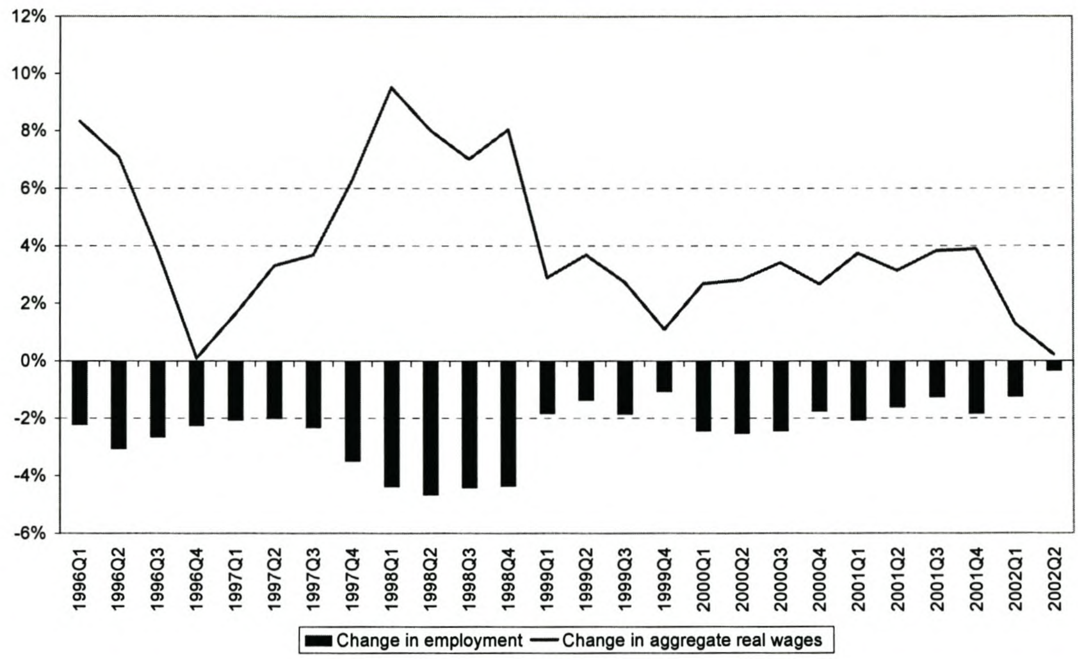
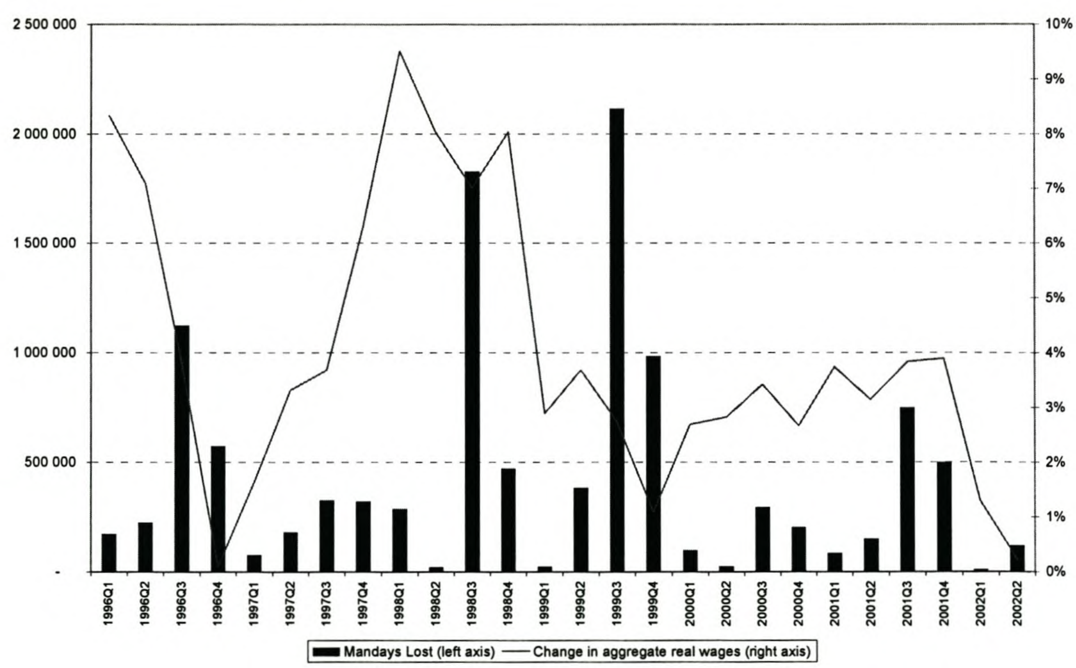



**Figure 9-11**: Union power and wage determination



## 9.4. Statistical and econometric tests

### 9.4. (a) Tests for stationarity

As was argued in the previous chapter, the time-series characteristics of the data must inform the econometric technique that needs to be used. This section conducts unit root tests on the key variables used in the labour market bloc, with the augmented Dickey Fuller test used throughout.

**Table 9-3**: Tests for unit root

| | ADF test levels (intercept) | ADF test first differences (intercept) | ADF test levels (trend and intercept) | ADF test first differences (trend and intercept) | ADF test in levels (none) | ADF test in first differences (intercept) |
|---|---|---|---|---|---|---|
| Number of people employed | -0.360 | -3.478** | -3.141 | -3.670** | -0.944 | -3.367*** |
| Real wage rate | 1.063 | -5.003*** | -0.641 | -5.200*** | 3.362 | -4.004*** |
| Output per worker | 3.324 | -4.288*** | -0.421 | -6.579*** | 3.961 | -3.051*** |
| Real gross value added | 0.523 | -4.416*** | -1.449 | -4.479*** | 2.417 | -3.660*** |
| User cost of capital | -1.987 | -3.600*** | -1.927 | -3.687** | -0.564 | -3.642*** |
| Openness | -0.781 | -3.210** | -2.104 | -3.177* | 0.601 | -3.143** |

* *Significant at 10 per cent*
** *Significant at 5 per cent*
*** *Significant at 1 per cent*
*Null hypothesis is unit root*

The results of the tests on the levels of the variables indicate that there is evidence that all variables have a unit root in the levels (reported in the unshaded cells) but do not in first differences (reported in the shaded cells). This means that variables are integrated of the order one, or are I(1) variables.

### 9.4. (b) Correlation coefficients

Table 9-4 gives correlation coefficients for the key variables used in the analysis. It is clear that the number of people employed (private sector, non-agricultural) is highly negatively correlated to the real wage rate. This emerged too from the graphical analysis above. There is also a strong correlation between output per worker and real wage rate, but theory is less clear on the direction of causation (Wakeford 2003 suggests the direction of is from output per worker to wages, not the other way around). Many of the other correlations can be explained quite simply by virtue of their specification. For example, with employment and output per worker, more workers will lead to a rise of employment and a fall in the output per worker.

**Table 9-4**: Correlation coefficients

| | Number of people employed | Real wage rate | Output per worker | Real gross value added | User cost of capital | Openness |
|---|---|---|---|---|---|---|
| Number of people employed | 1.00 | | | | | |
| Real wage rate | -0.97 | 1.00 | | | | |
| Output per worker | -0.97 | 0.99 | 1.00 | | | |
| Real gross value added | -0.92 | 0.96 | 0.98 | 1.00 | | |
| User cost of capital | -0.65 | 0.68 | 0.67 | 0.70 | 1.00 | |
| Openness | -0.93 | 0.91 | 0.92 | 0.90 | 0.75 | 1.00 |

### 9.4. (c) Granger causality tests

Granger (1969) causality tests are presented below to get a better feel of what the direction of the causality is between variables. Without exhaustively discussing all the combinations presented in Table 9-5, the results in line with those presented in Wakeford (2003) and as suggested by the theory discussed in chapters 2 and 6. Granger causality is naturally a statistical construct and can only give a sense of the direction of causation between variables.

**Table 9-5**: Granger causality tests

| | Obs | F-Statistic | Probability |
|---|---|---|---|
| *Real Wages → Employment* | *129* | *4.76439* | *0.01015* |
| Employment → Real Wages | | 0.70468 | 0.49624 |
| *Output Per Worker → Employment* | *129* | *5.76785* | *0.00403* |
| Employment → Output Per Worker | | 0.02592 | 0.97442 |
| *Gross-Value Added → Employment* | *129* | *7.21003* | *0.00109* |
| *Employment → Gross-Value Added* | | *9.37721* | *0.00016* |
| User Cost Of Capital → Employment | 86 | 1.72396 | 0.18484 |
| Employment → User Cost Of Capital | | 0.50263 | 0.60681 |
| *Openness → Employment* | *126* | *4.48823* | *0.01317* |
| Employment → Openness | | 1.07195 | 0.34557 |
| Output Per Worker → Real Wages | 129 | 2.72786 | 0.06928 |
| Real Wages → Output Per Worker | | 0.69813 | 0.49946 |
| Gross-Value Added → Real Wages | 129 | 0.13843 | 0.87086 |
| *Real Wages → Gross-Value Added* | | *3.27988* | *0.04092* |
| User Cost Of Capital → Real Wages | 86 | 1.79472 | 0.17272 |
| Real Wages → User Cost Of Capital | | 0.01868 | 0.98150 |
| *Openness → Real Wages* | *126* | *3.43817* | *0.03529* |
| Real Wages → Openness | | 2.82535 | 0.06321 |
| Gross-Value Added → Output Per Worker | 129 | 1.98377 | 0.14189 |
| *Output Per Worker → Gross-Value Added* | | *3.96463* | *0.02143* |
| *User Cost Of Capital → Output Per Worker* | *86* | *3.99231* | *0.02220* |
| Output Per Worker → User Cost Of Capital | | 0.15626 | 0.85560 |
| Openness → Output Per Worker | 126 | 0.00535 | 0.99466 |
| *Output Per Worker → Openness* | | *3.78829* | *0.02536* |
| User Cost Of Capital → Gross-Value Added | 86 | 1.88947 | 0.15775 |
| Gross-Value Added → User Cost Of Capital | | 0.08365 | 0.91983 |
| Openness → Gross-Value Added | 126 | 1.28944 | 0.27918 |
| *Gross-Value Added → Openness* | | *3.71846* | *0.02709* |
| *Openness → User Cost Of Capital* | *86* | *4.21752* | *0.01810* |
| *User Cost Of Capital → Openness* | | *3.21740* | *0.04523* |

*Null hypothesis: Indicated Granger causality does not hold*
*Italics denote that there is evidence that the left hand variable Granger causes the right-hand one at the 5 per cent level of confidence.*

There are some interesting results, however, which merit some discussion. Gross-value added is found to Granger cause employment and *vice versa*. This can be ascribed to one of the fundamental problems of the production function, that there are feedback effects present. Using a structural model does to some extent allow for the feedback effects to be captured. Another interesting result is that a number of variables (amongst them real wages, output per worker, gross-value added and user cost of capital) have an effect on openness. In this sense, the Granger causality test is most likely capturing the fact that openness is measured by imports and exports as a proportion of GDP. This suggests that these variables may either influence the level of exports or the level of imports, and hence the calculated openness of the economy. Unfortunately, how these variables influence openness is beyond the scope of this thesis, but it does highlight some of the issues regarding feedback in the macroeconomy.

### 9.4. (d) Tests for exogeneity

As was noted in section 8.3(c) above, it is important to determine whether or not the variables within the system that has been estimated can be regarded as weakly exogenous. This was tested by constructing a small VECM comprising the variables that were used in the analysis. It was found that all the variables of interest are weakly exogenous, with the exception of output. This is largely as expected as output may be determined by a number of factors.

In addition, the feedback effect of employment to output introduces the strongest argument for using a structural model rather than a VECM. Economic theory suggests that a vast array of variables cause output, and that employment is only one. A VECM-type structure may then introduce omitted variable bias into the output equation, leading to estimates of the true parameters being inadequate for the purposes of this thesis.

This makes it difficult to carry out simulations where output is the variable of interest. The procedure that will be followed is to exogenise a component of output. The shock is also designed to get the magnitude of change required in the output variable.

By combining the results of the weak exogeneity tests with the Granger causality tests reported in section 9.4(c), it can also be established that the conditions for strong exogeneity hold with the exception, once again, being output.

## 9.5. Conclusion

This chapter set out the data that will be used in the econometric functions that will be estimated in the following chapter. It was found that an exploratory data analysis suggests that the theoretical relationships between the variables do hold. That is to say that output per worker and real wages are positively correlated, as are output and employment, whilst real wages are negatively correlated with employment.

On a more technical note, the econometric tests indicated that the variables of interest are all non-stationary. This suggests the use of cointegration techniques. In addition, the presence of feedback effects (endogeneity) was noted (for example, there is evidence that while output leads to higher employment, the reverse is also true). This suggested the use of a structural model to ensure that the parameter estimates are true.

# Chapter 10: Econometric Functions

## 10.1. Introduction

This section sets out the estimated econometric functions. An employment bloc consisting out of a demand for labour equation and a real wage rate equation was estimated. The purpose is essentially to estimate the bloc as a mini-model in of itself. In the following chapter, the bloc will be introduced into the full model to test the economy-wide effects of changing a number of variables.

## 10.2. Individual equations

### 10.2. (a) Demand for labour equation

*a. Theory revisited*

The demand for labour equation was estimated following a standard production function approach, i.e.

$$l = \beta_0 + \beta_1 w + \beta_2 r + \beta_3 q + \beta_4 z \qquad [\ 10\text{-}1\ ]$$

where $l$ is the number of workers, $w$ the real wage, $r$ a measure of the cost of capital or a real interest rate (capturing the cost of the nearest substitute) and $q$ is a measure of output or gross-value added. The $\beta$ terms are coefficients and $z$ is a vector of structural factors. For $z$, some of the literature (e.g. Fallon and Lucas 1998) suggests including a trend. The trend could capture the evolution of technology or labour shedding. Other alternatives for structural factors are openness or structural change dummies.

This specification is consistent with both the theoretical and applied literature reviewed above.

*b. Estimation and results*

Four equations are presented. Equations 1(a) and 2(a) use real gross domestic product for the $q$ term and equations 1(b) and 2(b) use gross-value added. As has been shown in chapter 5, the latter is theoretically more correct. Choosing gross-value added rather than output does not, however, dramatically change the coefficients of the other terms. This indicates that the equations are robust to the definition of output.

The first set of equations (equations 1a and 1b) indicate that the calculated long-run wage elasticity of employment is approximately –0.66. This compares favourably with the majority of studies reviewed[40]. In equation 1a, where real GDP is used as a measure of output, the long-run output elasticity of employment is calculated as approximately +0.67.

This is an interesting result: what it implies is that for every one per cent rise in real wages, a one per cent rise in real GDP is needed to keep employment constant[41]. This result is borne out by a Wald test, which indicates that there is evidence that the coefficients are of a similar order of magnitude, although of opposite sign.

In equation 1b, where gross-value added is the measure of output, the calculated long-run output elasticity of employment is 0.75. Ideally, one would expect that a one per cent rise in output would mean a one per cent rise in employment. However, South Africa's rising capital: labour ratio would indicate otherwise: growth has been relatively more capital intensive. Given this stylised fact, an output elasticity of between 0.66 and 0.75 appears to be broadly correct[42]. Depending on estimation technique, the long-run elasticity of user cost of capital is estimated at +0.18 and +0.23. This suggests that a one per cent rise in the price of capital will lead to an increase in the increase in employment of approximately 0.2 per cent, *ceteris paribus*. *A priori*, one does expect a positive elasticity if capital and labour are substitutes, which it appears they are[43].

The estimated half-life is quite quick, with half the change to the long-run variables realised within 2½ quarters.

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[40] The exception is Du Toit and Koekemoer (2003). They calculate a long-run wage elasticity of –0.198.

[41] Between 1990q1 and 2002q3, formal-sector real wages grew by a cumulative 46 per cent. Real GDP grew by only 26 per cent. Unsurprisingly, formal-sector employment fell by 19 per cent.

[42] For reasons of exogeneity, this parameter estimate should be treated with care. In the following chapter, the true parameter is calculated to be slightly higher.

The dynamics are also broadly in line with the theoretical discussion above. The negative coefficient on real wages shows that a one per cent increase in real wages will lead to a short-run fall in employment of 0.16 per cent, after which the fall in employment will tend to the long-run elasticity. For output, when measured by real GDP the short-run coefficient is 0.20 and when measured by gross value added, the coefficient is 0.26.

The second set of equations (2a and 2b) is a restricted version of the first set. In the second set, user cost of capital variable and the openness indicator are dropped. The result of restricting the equation is that the calculated long-run elasticities of both real wages and output rise. The wage elasticity of employment is calculated at –0.77 for both equation 2a and 2b. The output elasticity of employment is calculated at +0.88 and +0.94 for equations 2a and 2b respectively.

A Wald test was used for a test of the restriction that both coefficients are equal to zero. The test rejects the restriction. The test also rejects the restriction that the coefficients are separately equal to zero. This suggests that equations 2a and 2b may be prone to omitted variable bias.

This suggests that equations 1a and 1b are better for the econometric estimation. In addition, after consideration, equation 1a was chosen for the simulations. This was for a number of reasons, including:

- The calculated elasticities correspond to those estimated by other researchers;
- The use of gross value added as the variable measuring output is theoretically correct; and
- Including variables such as user cost of capital and openness ensures that structural factors are also included in the specification.

The full results are reported in Table 10-1.

[43] This is also borne out by the rising capital: labour ratio, even as output increases.

**Table 10-1**: Estimated equation – number employed (formal, non-agricultural private)

| | Equation 1(a) | Equation 1(b) | Equation 2(a) | Equation 2(b) |
|---|---|---|---|---|
| Sample period: | 1980Q1 to 2002Q3 | 1980Q1 to 2002Q3 | 1980Q1 to 2002Q3 | 1980Q1 to 2002Q3 |
| Observations | 87 | 87 | 87 | 87 |
| Dependent variable | | | | |
| **Δ*Log*(Employed in millions)** | | | | |
| **Long-run** | | | | |
| Error-correction: *Log*(Employed, million $_{t-1}$) | -0.285** (-6.32) | -0.285** (0.04) | -0.145** (0.02) | -0.138** (0.02) |
| *Log*(Real wage rate $_{t-1}$) | -0.189** (6.17) | -0.189** (0.03) | -0.113** (0.02) | -0.108** (0.02) |
| *Log*(Real GDP $_{t-1}$) | 0.202** (0.04) | - | 0.128** (0.03) | - |
| *Log*(Gross value added $_{t-1}$) | - | 0.215** (0.04) | - | 0.13** (0.03) |
| Trend (1980Q2 = 1) | -0.001** (0) | -0.001** (0) | 0** (0) | 0** (0) |
| (User cost of capital $_{t-1}$) | 0.055** (0.03) | 0.066** (0.03) | - | - |
| (Openness$_{t-1}$) | -0.001** (0) | -0.001** (0) | - | - |
| **Calculated** | | | | |
| Long-run elasticity: | | | | |
| Real wages | -0.6611 | -0.6619 | -0.7767 | -0.7796 |
| Real GDP / GVA | 0.6771 | 0.7528 | 0.8867 | 0.9434 |
| User cost of capital | 0.1840 | 0.2313 | - | - |
| Openness | -0.003 | -0.003 | - | - |
| Half life calculation (quarters) | 1.7 | 1.7 | 3.45 | 3.6 |
| **Constant** | -0.032 ** (0.26) | 0.7** (0.26) | -0.238 ** (0.26) | 0.285 ** (0.21) |
| **Dynamics** | | | | |
| Δ*Log*(Real wage rate) | -0.166** (0.04) | -0.169** (0.04) | -0.159** (0.04) | -0.16** (0.04) |
| Δ*Log*(Real GDP) | 0.259** (0.06) | - | 0.325** (0.07) | - |
| Δ*Log*(Gross value added) | - | 0.204** (0.06) | - | 0.231** (0.06) |
| Impulse dummy 1990Q1 | 0.012** (0.01) | 0.014** (0.01) | 0.013** (0.01) | 0.013** (0.01) |
| Impulse dummy 1998Q1 | -0.011** (0.01) | -0.012** (0.01) | -0.013** (0.01) | -0.015** (0.01) |
| R-squared | 0.655845 | 0.621497 | 0.646390 | 0.601431 |
| Adjusted R-squared | 0.610562 | 0.571694 | 0.611891 | 0.562546 |
| S.E. of regression | 0.004683 | 0.004912 | 0.005128 | 0.005444 |
| Sum squared residuals | 0.001667 | 0.001833 | 0.002156 | 0.002430 |
| Log likelihood | 349.0767 | 344.9385 | 355.4631 | 350.0174 |
| Durbin-Watson statistic | 2.042240 | 1.931108 | 2.080627 | 1.953152 |
| *P-values for* | | | | |
| Jacque-Bera normality test | 0.84 | 0.89 | 0.81 | 0.88 |
| Serial correlation test | 0.89 | 0.91 | 0.85 | 0.34 |
| ARCH LM test | 0.89 | 0.71 | 0.31 | 0.24 |
| White heteroscedasticity | 0.60 | 0.64 | 0.06 | 0.06 |

Figures in parenthesis are standard errors.
* Significant at 10% level
** Significant at 5% level

c. *Econometric tests*

The summary econometric tests reported in Table 10-1 (R-squared, adjusted R-squared, standard error of regression etc.) indicate that the results are econometrically correct.

To test for co-integration, the same approach as for the real wage equation was followed. Here the co-integration test for equation 1(b) is discussed, as it was used in the policy simulations.

There is also evidence that the long-run portion of the regression cointegrates. As was discussed in section 8.2. (e) on page 117, this is done in two steps. First the long-run portion is estimated separately and the residual series created. Second the residual is tested for evidence of stationarity. It is found that the residual is indeed stationary, which shows that there is evidence of co-integration (ADF test statistic of –2.67, which is statistically significant at the 5% level). An alternate approach is to do a Johansen co-integration test, as set out in the previous chapter (or in Harris 1995). The results of a summarised Johansen test using all six assumptions on the nature of the intercept and trend are presented in Table 10-2 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 in section 9.4 shows that the direction of causation is real wages to employment, GVA to employment and openness to employment.

**Table 10-2**: Johansen co-integration test for demand for labour equation

| Data Trend: | None | None | Linear | Linear | Quadratic |
|---|---|---|---|---|---|
| Rank or No. of CEs | No Intercept No Trend | Intercept No Trend | Intercept No Trend | Intercept Trend | Intercept Trend |
| Selected (5% level) Number of Cointegrating Relations by Model (columns) | | | | | |
| Trace | 1 | 1 | 0 | 1 | 1 |
| Max-Eig | 0 | 0 | 0 | 1 | 1 |

### 10.2. (b) Real wage rate equation

*a. Theory revisited*

The theoretical basis for the wage rate equation is taken from Layard *et al* (1992). Recall from the discussion in section 6.3(b) that the way in which nominal wages are determined can be represented as follows:

$$w_i = \lambda[p_i - b_{01} + b_2\alpha(k_i - n_{i-1})] + (1-\lambda)(w^e + c_0 - c_i u - c_2\Delta u + c_3\hat{z}_w) + \hat{z}_{1w} \quad [\text{ 6-16 }]$$

where $\lambda$ reflects the degree of unionisation. The first half of the equation then reflects the 'insiders', who make up a proportion equal to $\lambda$ 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 - $\lambda$) 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 section 4.3), 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 equation [6-16] is clearly somewhat complex.

Table 10-3 presents five different 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 0.75. That is to say that a one per cent increase in labour productivity will lead in the long-run to a 0.75 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 half-life of the regression is relatively quick. Equation (3) has the slowest adjustment and it takes wages 1½ quarters to adjust to changes in output per worker. The quickest speed of adjustment is in Equation (5), and the speed of adjustment is 1.15 quarters.

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

- **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)[44].

[44] 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 thesis, the moving average of past CPIX inflation is used as a proxy for inflation expectations (cf. Fair 1984).

It is estimated that a one per cent increase in unanticipated inflation leads to a fall of between 0.68 and 0.78 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.

- **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.

- **Union power**. In the estimation, two different indicators of union power are used, *viz.* the proportion mandays lost and the proportion of unionised workers. As discussed in section 8.3, the first was calculated by taking the number of mandays lost as a proportion of the total mandays available. Equation 1 and 2 use both measures, equation 3 and 5 use only mandays lost and equation 4 only unionisation. As the table shows, the coefficients are robust and statistically significant across all the specifications.

Other variables are also found to be significant depending on the specification. These are:

- **Openness**, which is measured by the proportion of exports and imports to GDP. It is found that the more open the economy, the lower the real wage. This is to be expected as the more open the economy became in the 1990s, the more competitive labour had to become. In equation 1 and 3 it is found that the coefficient is –0.247 and –0.2 respectively.

- **Tax as proportion of GDP**. The higher direct and indirect taxes are as a proportion of GDP, the higher the real wage. This is to be expected if workers can fund increases in their tax burden by demanding higher real wages.

- **Structural break dummies**. In some of the specifications, structural break dummies for the transition to democracy (first quarter of 1994) and the implementation of the government's Growth, Employment and Redistribution strategy (GEAR) are statistically significant and negative. This is as expected because both events began a process where the economy became more integrated with the global economy (see discussion in section 2.7).

Other variables that are 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.

- **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 10-3**: Estimated equation – real wage rate (formal, non-agricultural private)

| Variables | Equation 1 | Equation 2 | Equation 3 | Equation 4 | Equation 5 |
|---|---|---|---|---|---|
| Sample period: 1986q2-2002q3 | | | | | |
| Observations | 66 | 66 | 66 | 66 | 66 |
| Dependent variable $\Delta$*Log*(Real wages) | | | | | |
| **Long-run** | | | | | |
| Error-correction: *Log*(Real wages $_{t-1}$) | -0.351** | -0.367 ** | -0.37** | -0.335** | -0.429** |
| | (0.1) | (0.09) | (0.1) | (0.09) | (0.1) |
| *Log*(Output per worker $_{t-1}$) | 0.26 ** | 0.273 ** | 0.272** | 0.25** | 0.314** |
| | (0.07) | (0.07) | (0.07) | (0.07) | (0.07) |
| **Calculated** | | | | | |
| Long-run elasticity: output per worker | 0.74 | 0.74 | 0.81 | 0.68 | 0.73 |
| Half-life calculation | 1.4 | 1.4 | 1.5 | 1.4 | 1.4 |
| **Constant** | 0.788 ** | 0.818 ** | 0.865 | 0.739 | 1.008 |
| | (0.25) | (0.24) | (0.26) | (0.24) | (0.25) |
| **Dynamics** | | | | | |
| $\Delta$*Log*(Unanticipated inflation) | -0.729 ** | -0.718 ** | -0.783 ** | -0.684 ** | -0.624 ** |
| | (0.18) | (0.17) | (0.18) | (0.16) | (0.17) |
| $\Delta$*Log*(Output per worker) | 0.598 ** | 0.537 ** | 0.622 ** | 0.491 ** | 0.655 ** |
| | (0.17) | (0.16) | (0.17) | (0.16) | (0.16) |
| $\Delta$*Log*(Mandays lost/Total mandays) | 0.002 ** | 0.001 * | 0.002 ** | - | 0.002 ** |
| | (0) | (0) | (0) | | (0) |
| $\Delta$*Log*(Union workers/Total workers) | 0.104 ** | 0.094 ** | - | 0.118 ** | - |
| | (0.05) | (0.05) | | (0.04) | |
| $\Delta$(Openness) | -0.247 * | - | -0.200 * | - | - |
| | (0.25) | | (0) | | |
| $\Delta$(Tax as proportion of GDP) | 0.016 * | - | - | - | 0.017 ** |
| | (0.02) | | | | (0.02) |
| $\Delta$(Capacity utilisation $_{t-1}$) | - | - | - | - | -0.006 * |
| | | | | | (0) |
| Impulse dummy 1994q1 | -0.016 * | - | -0.02 ** | -0.015 * | -0.018 * |
| | (0.01) | | (0.01) | (0.01) | (0.01) |
| Impulse dummy 1996q1 | -0.017 * | - | -0.012 ** | -0.02 ** | - |
| | (0.01) | | (0.01) | (0.01) | |
| R-squared | 0.572043 | 0.514413 | 0.523961 | 0.560635 | 0.590908 |
| Adjusted R-squared | 0.494232 | 0.465031 | 0.457148 | 0.508507 | 0.531403 |
| S.E. of regression | 0.010449 | 0.010746 | 0.010825 | 0.010583 | 0.009908 |
| Sum squared resid | 0.006005 | 0.006813 | 0.006680 | 0.006607 | 0.005400 |
| Log likelihood | 213.4098 | 209.2408 | 209.8961 | 213.9438 | 209.3577 |
| Durbin-Watson stat | 2.026344 | 2.154615 | 1.992584 | 2.164085 | 2.145395 |

Figures in parenthesis are standard errors.
* Significant at 10% level
** Significant at 5% level

c. *Econometric tests*

The summary econometric tests reported in Table 10-3 (R-squared, adjusted R-squared, standard error of regression etc.) indicate that the results are econometrically correct.

There is also evidence that the long-run portion of the regression cointegrates. It is found that the residual is indeed stationary, which shows that there is evidence of stationarity (ADF test statistic of –3.300, which is statistically significant at the 5% level). The results of a summarised Johansen test using all six assumptions on the nature of the intercept and trend are presented in 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. The Granger causality test in section 9.4 shows that the direction of causation is from productivity to real wages[45].

**Table 10-4**: Johansen co-integration test: real wage equation

| Data Trend: | None | None | Linear | Linear | Quadratic |
|---|---|---|---|---|---|
| Rank or No. of CEs | No Intercept No Trend | Intercept No Trend | Intercept No Trend | Intercept Trend | Intercept Trend |
| Selected (5% level) Number of Cointegrating Relations by Model (columns) | | | | | |
| Trace | 1 | 1 | 0 | 0 | 0 |
| Max-Eig | 1 | 1 | 0 | 0 | 0 |

After careful consideration, equation 5 was chosen for the policy simulations in the following chapter, based on theoretical and econometric characteristics.

## 10.3. Conclusion

This chapter set out two econometric functions, which considered how structural factors from the microeconomic level can be incorporated into a time-series approach. There are two constraints to the findings. The first is the methodology. Time-series econometrics tend to be used for macroeconomic analyses and do not offer an immediately apparent way of incorporating microeconomic foundations. As far as possible, the functions attempted to include these foundations. The second constraint is that of the data, which does mean that the parameter estimates must be seen as indicative, rather than conclusive.

These constraints notwithstanding, the empirical analysis suggests that:

- There is little evidence that the efficiency wage hypothesis holds. When considering the Granger causality tests in the previous chapter and the econometric results in this one, it would appear that higher productivity causes higher wages. Higher wages do not, however, lead to higher productivity;
- There is evidence that the insider-outsider theory does hold. Union activity, as measured by either by unionisation or by mandays lost, leads to higher real wages in the short-run.
- There is some evidence short-run disequilibria. Depending on the specification, the half-life calculation for the demand for labour is approximately 1½ quarters, which suggests that the dependent variable reverts to the long-run equilibrium within three quarters.

Overall, this chapter suggests that it is possible to consider microeconomic factors within a macroeconomic framework. That said, econometric work using micro-level data-sets would complement these findings and allow a better understanding of some of the more subtle issues.

The next chapter takes the empirical analysis one step further, by considering the broader effects of changes to key variables.

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[45] This indicates that the efficiency wage hypothesis does not hold in South Africa, a finding corroborated by Wakeford (2003): it would seem that increased real wages do not lead to higher productivity.

# Chapter 11: Simulations

## 11.1. Introduction

The key contribution that this chapter attempts to make is to consider the effect on employment of a set of simulations, to better understand the demand for labour within the context of the larger economy. The simulations below do not represent policy shocks, *per se*, but rather capture the possible effects of indirect policies. The ability of policy makers to undertake active policy measures is somewhat constrained by:

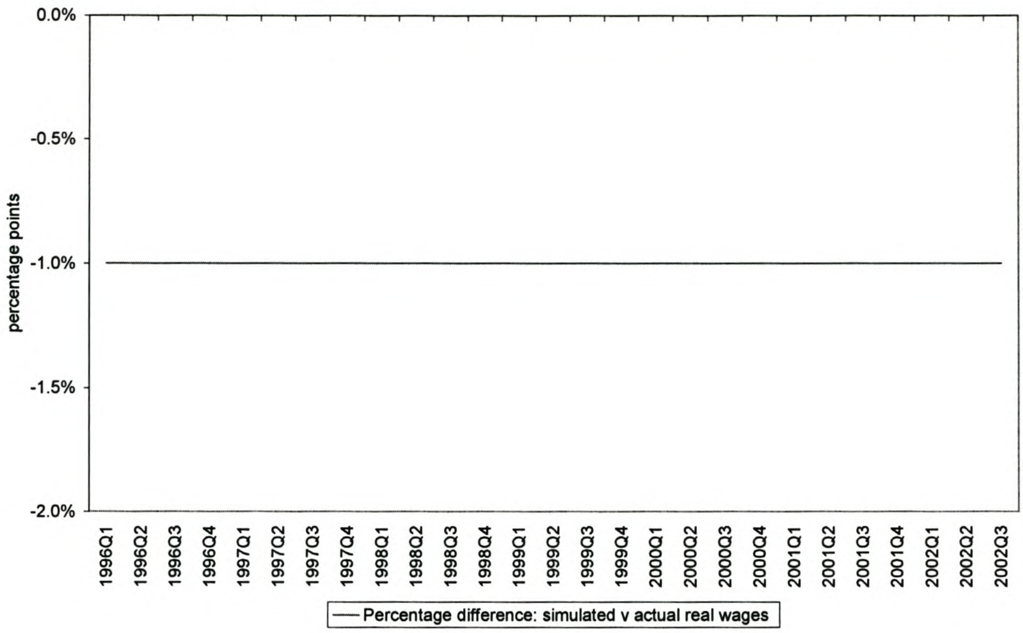
- the political economy of the country, including the issues touched on in chapter 4;
- the diversified, free market nature of the economy, which limits the government's scope to intervene directly to achieve its desired objectives;
- the lack of both resources and capacity within government to analyse and implement active labour market policies; and
- the existence of competing objectives, which relates to the need to reconcile policies aimed at protecting vulnerable workers with policies aimed at expanding job opportunities.

## 11.2. Simulation A: Wage restraint – Fall in real wages of 1 per cent

### 11.2. (a) Nature of the shock

The first shock considered is a simulation where the real wages are 1 per cent lower than in the baseline. The shock is summarised in Figure 11-1. It shows that real wages are simulated to be 1 per cent lower than in the baseline scenario.

**Figure 11-1**: Simulation A – Fall in real wages of 1 per cent

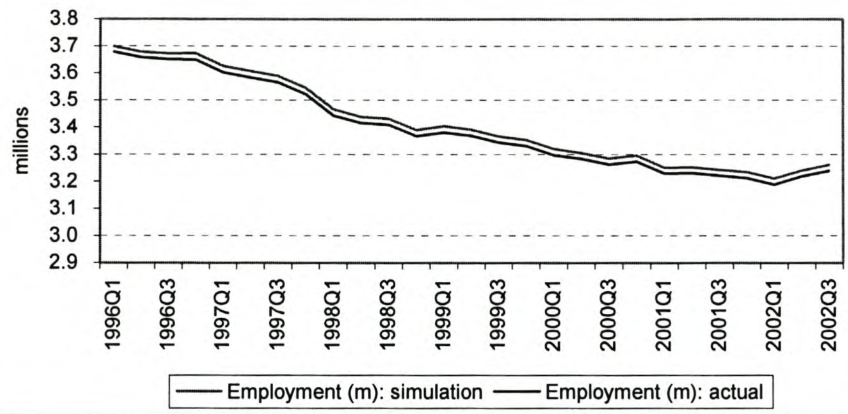



### 11.2. (b) Effect on employment

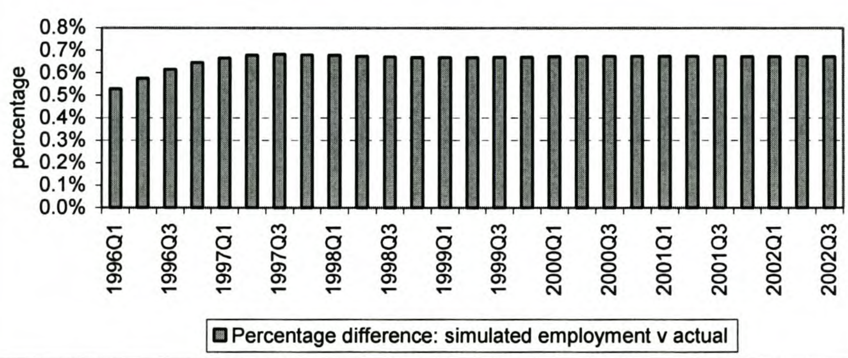
*A priori,* one would expect a rise in employment. As expected, a fall in real wages is positive for employment, as is shown in Figure 11-2 (panel a). Employment rises within 3 quarters by the wage elasticity, i.e. 0.67 per cent (panel b) and approximately 25 000 jobs are created within eight quarters (panel c).

**Figure 11-2**: Simulation A – Effect on employment

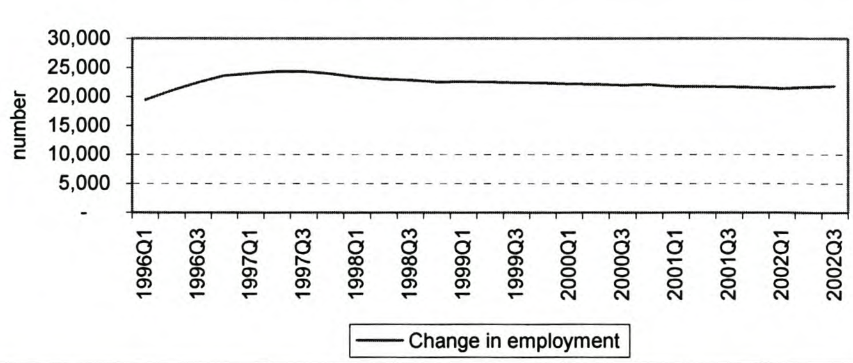
(a) Employment levels




(b) Percentage change in employment




(c) Change in number employed



### 11.2. (c) Other economic variables

Figure 11-3 shows the effect on other key economic variables in the model. As has been shown, theoretically the effect on output of a fall in wages is ambiguous[46]. In this model, the stimulus of more jobs initially boosts the economy and GDP growth rises marginally (panels a and b). Within time, however, and as predicted by Heinz (2003), there is a temporary fall in GDP growth. There is no additional support from further job creation and lower real wages feed through to disposable income and lower consumption expenditure. Over the longer run, i.e. within three years, the effect on output is negligible. It is found that overall, output is left marginally higher.

As a result of the output effect, in the longer run, too, the economy-wide wage elasticity is lower. The initial gains from the cut in wages are slowly eroded, but not by much (see Figure 11-2).

The capital labour ratio falls marginally as labour becomes relatively more attractive. The figure does not report it, but the rate of investment falls initially as a result too, but the fall is small (0,12 per cent). After some adjustment, investment stabilises back at the same level it was before, explaining the change in the capital labour ratio.

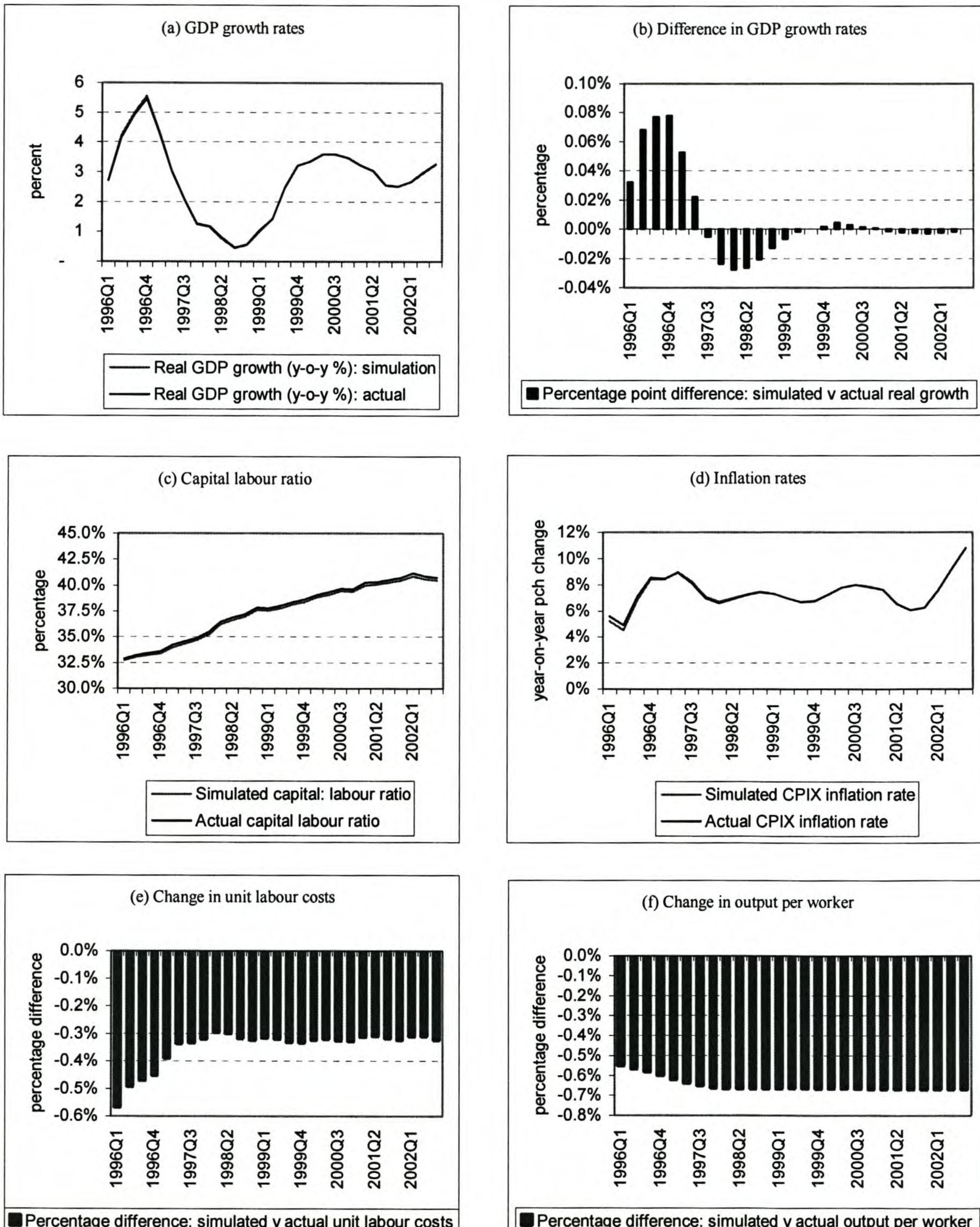
There is also a fall in unit labour costs (Figure 11-3, panel e). Unsurprisingly this is the greatest in the first few quarters, as real wages have fallen without a corresponding adjustment in the other components of real unit labour costs (productivity and output). Over time, the gains in unit labour cost slowly erode, but labour is approximately 0,33 per cent cheaper per unit of output over the long-run. Output per worker also falls (panel f). This is because although there is a marginal

[46] Chapter 2 argued that a fall in the relative prices of one factor will not only have scale effects, but substitution effects too. Scale effects, i.e. higher output, will occur because the overall cost of production has fallen. Marginal cost has fallen, so firms will increase production until, once again, marginal cost equals marginal revenue. There is, however, a valid argument that a decrease in real wages will reduce aggregate demand through its effect on disposable income (see chapter 4). Given that the model used to produce these results is demand-oriented, that there is still some positive effect on demand shows that there is little scope for an argument that real wages are unambigously bad for production.

increase in output there is a greater increase in workers. The fall in output per worker is approximately 0,67 per cent, which is also the wage elasticity of employment.

Overall, the actual employment gained by real wage cuts is relatively small: approximately 12 000 additional jobs are created, and GDP is approximately R46 million lower on average per year. Given the political sensitivity around the issue of real wage cuts and the small economic benefit gained, it does not appear that this is a useful strategy.

**Figure 11-3**: Simulation A – Other economic variables

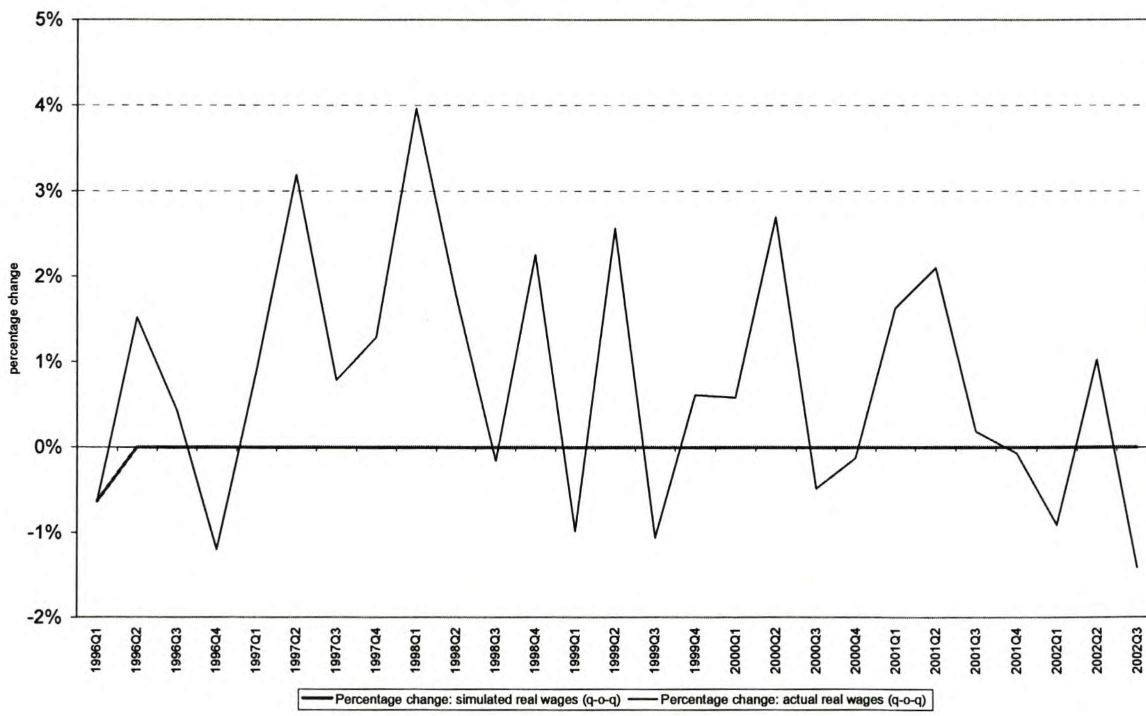


## 11.3. Simulation B: Wage moderation – Real wages staying constant over a seven-year period

### 11.3. (a) Nature of shock

Given the traditionally strong real wage growth experienced in South Africa over a protracted period of time, this simulation considers the effect of a no real wage growth over the period 1995 to 2002.

**Figure 11-4**: Simulation B – Real wages staying constant over a seven-year period



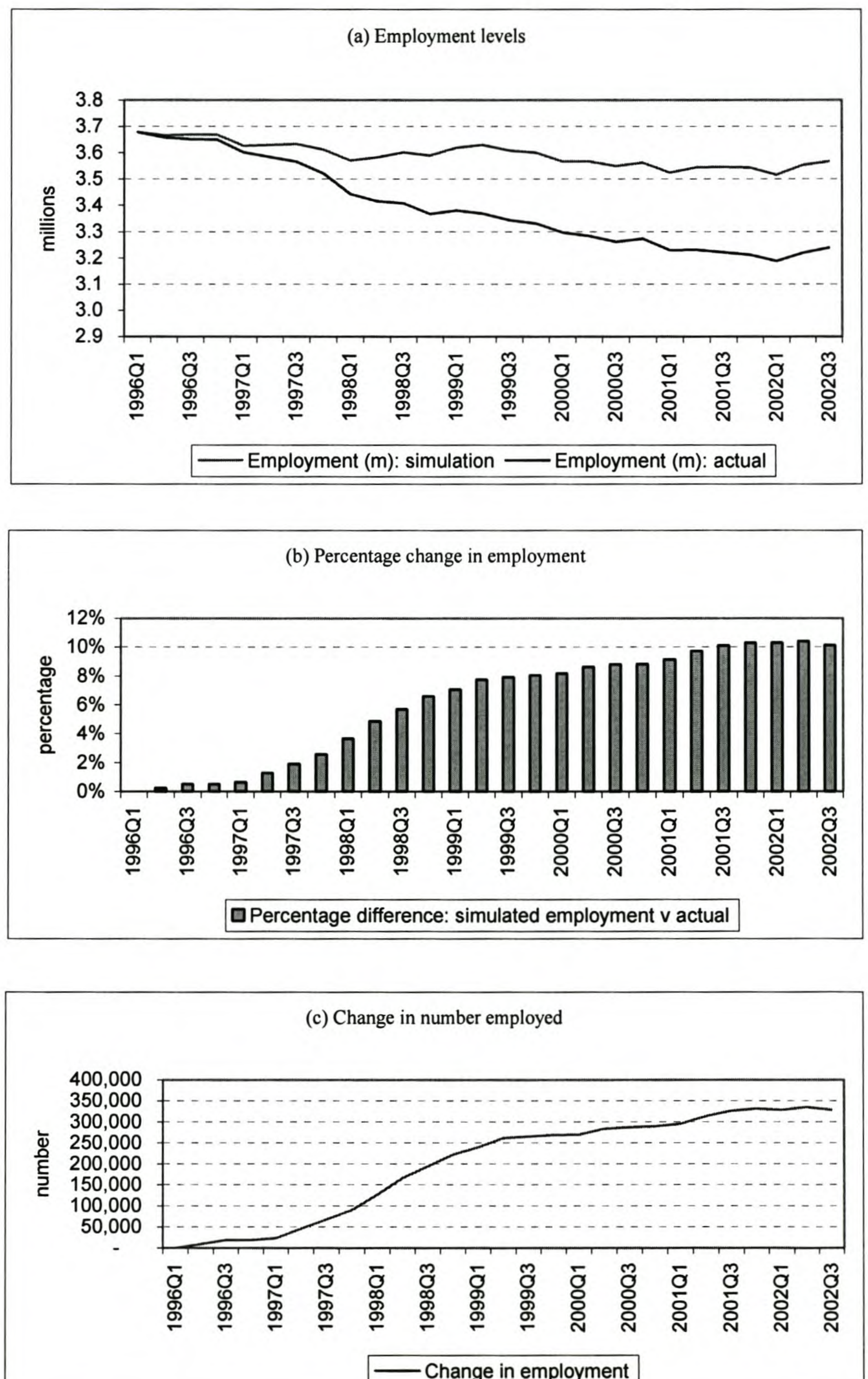

### 11.3. (b) Effect on employment

It is to be expected that the results will be broadly similar with those of the previous policy simulation. However, the results are reasonably dramatic.

As is shown in Figure 11-5, the net creation of employment is 436 000 jobs over the period. This represents a rise of 14 per cent in employment relative to the base scenario by 2002. To compare the wage restraint and wage moderation scenarios, it must be borne in mind that real wages have risen on average 3,8 per cent per annum.

In effect, modelling the effect wage moderation is equivalent to modelling a 3,8 per cent decline in real wages per annum.

**Figure 11-5**: Simulation B – Effect on employment



### 11.3. (c) Other economic variables

Once again the *a priori* effect on the GDP growth rate is expected to be ambiguous. In practice, the business cycle is exacerbated (Figure 11-6). Upswings are slightly more pronounced (0,5 per cent higher) and downswings lower (the Asian-crisis downswing is predicted to have been 0,5 per cent deeper). This is in line with the international literature discussed in section on page 47, which suggests that inflexible labour markets tend to dampen the business cycle.

Once again, the lower level of real wages feeds through to lower personal disposable income, and hence lower consumption, at least in the short-run. The job-creation in this scenario, however, is significant enough to keep consumption reasonably strong. In the presence of wage moderation, it is predicted that the output loss is approximately R 1,34 billion. This translates to approximately 1 per cent of GDP.

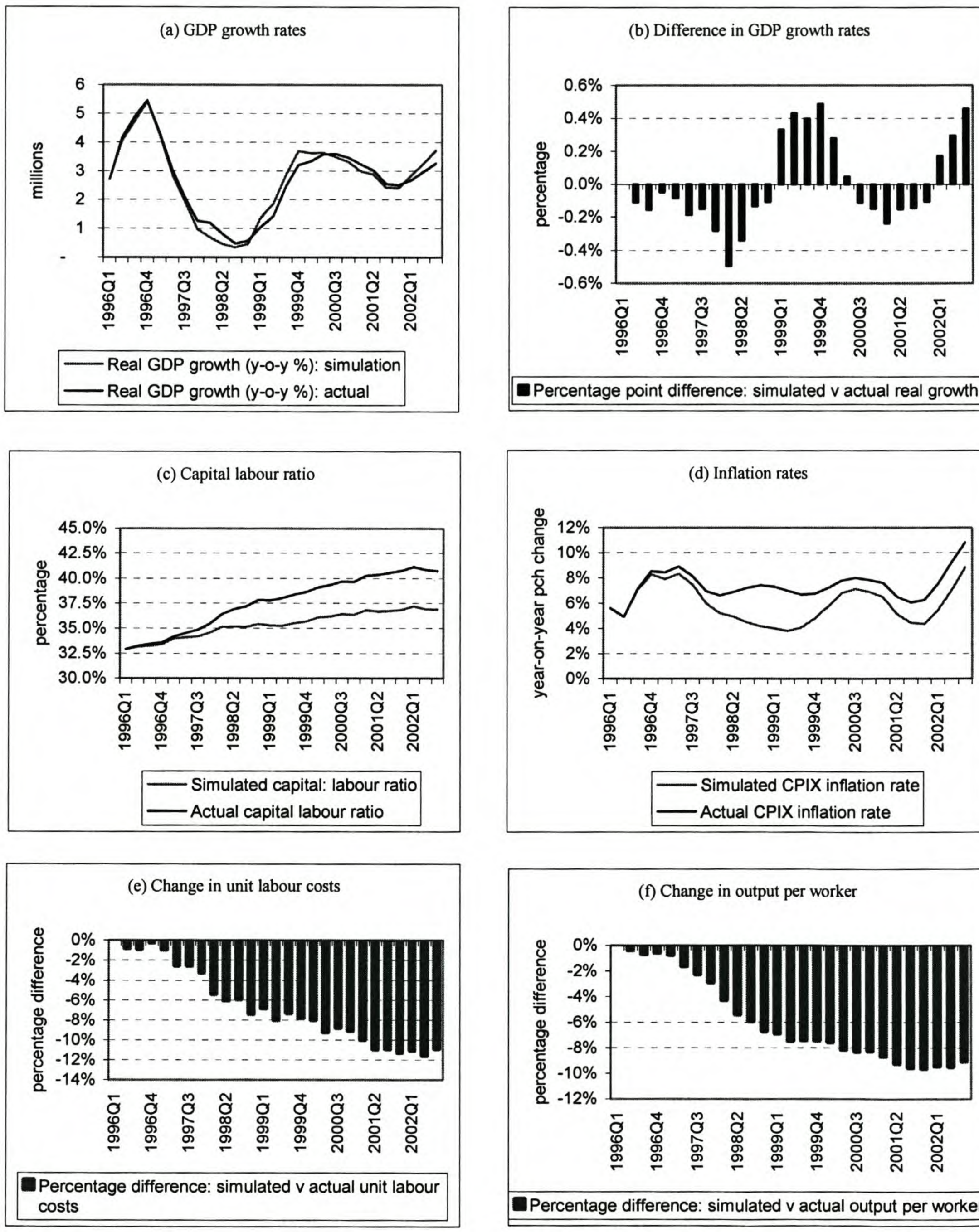
As a result of the shift in relative factor prices, investment and the capital stock is lower. The fall investment means that, by 2002, the capital labour ratio is simulated to be 36 per cent, against the actual capital labour ratio of 40 per cent. This can be ascribed to a shift toward more labour intensive output as the relative price of labour falls.

It has become widely accepted that rising wages (provided they feed into rising unit labour costs) are significantly inflationary (see Aron *et al* 2003 or South African Reserve Bank 2003). As a result of wage moderation it can be expected that inflation will fall if unit labour costs fall[47]. Panel (d) shows that inflation, measured in this case by the targeted CPIX, is lower on average. This can be ascribed to a fall in unit labour costs, which are forecasted to be 12 percent lower. As with the first scenario, the rise in employment is greater than the rise in GDP. As a result output per worker falls. In the longer-run, output per worker is simulated to be 10 per cent lower.

[47] Unit labour costs will not fall if the output fall is the same or greater than the fall in the wage bill.

Overall, this simulation shows that there are significant net positive benefits from encouraging wage moderation, for example through strengthening the credibility of the inflation-targeting framework and discouraging the exercising of union power.

**Figure 11-6**: Simulation B – Other economic variables

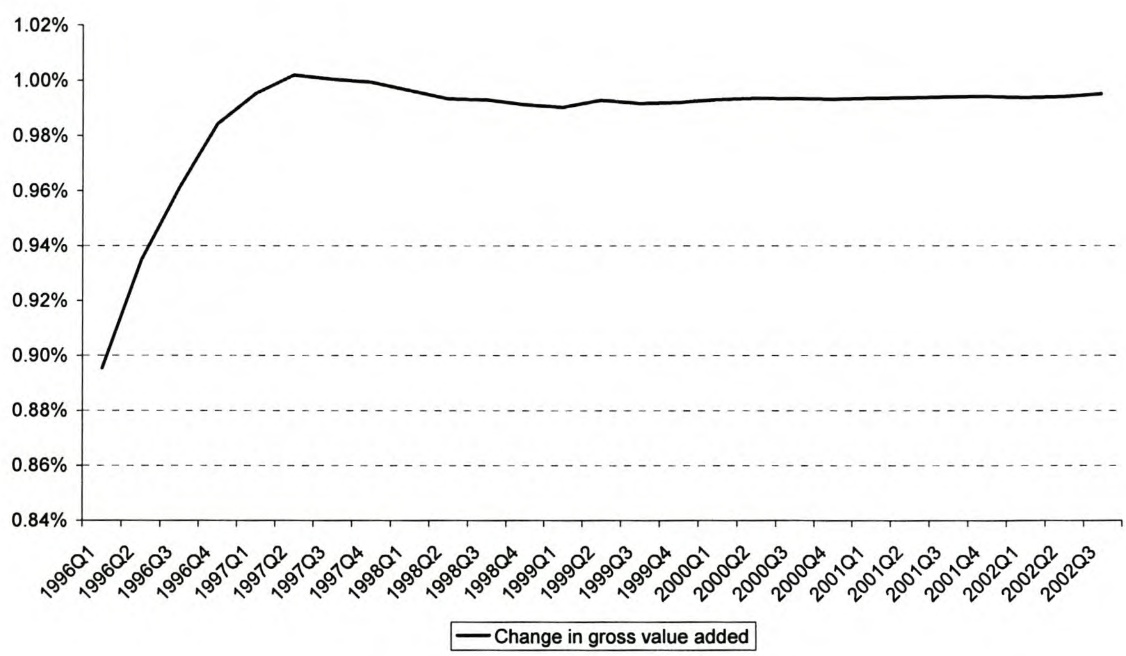


## 11.4. Simulation C: 1 percent higher *level* of output

### 11.4. (a) Nature of the shock

In this simulation, the level of gross-value added was simulated to be 1 per cent higher. Figure 11-7 shows the percentage difference between actual and simulated output.

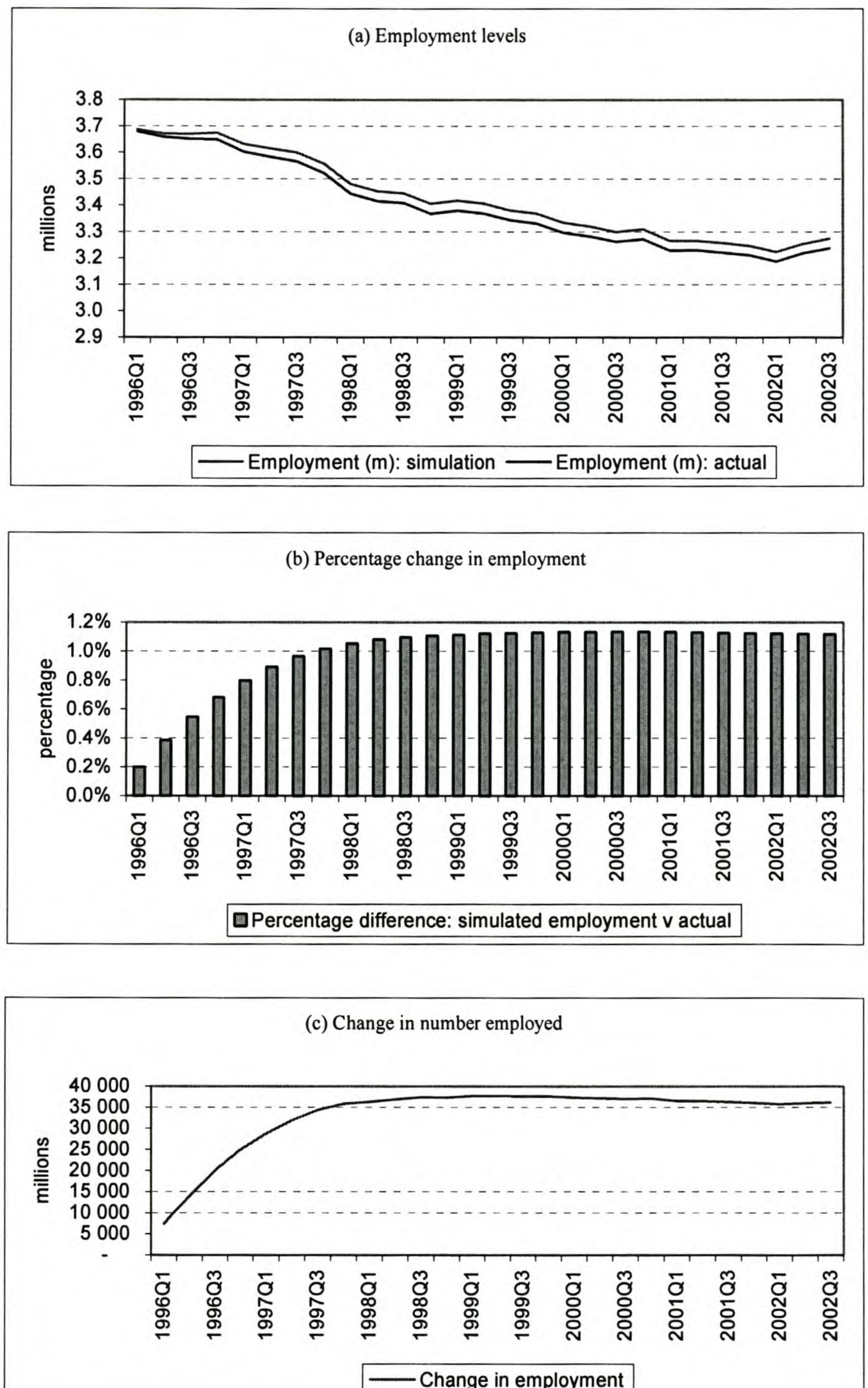
**Figure 11-7**: Simulation C – Higher *level* of output




### 11.4. (b) Effect on employment

As would be expected, the effect on employment is positive. In the longer term employment is simulated to rise 1,1 per cent. This effect is greater than the output elasticity of employment in the underlying estimated demand for labour, which was 0,75 in the single equations (cf. Table 10-1). The major contributing factor is a fall in real wages of 0,6 per cent. This fall comes about because the rise in output is initially greater than the rise in employment. This leads to falling output per worker, which by approximately 0,8 per cent. This fall in output per worker leads to lower real wage growth. Real wages thus fall by 0,6 per cent. This creates an additional stimulus for more workers as relative prices shift. There is thus a multiplier effect throughout the economy[48].

**Figure 11-8**: Simulation C – Effect on employment



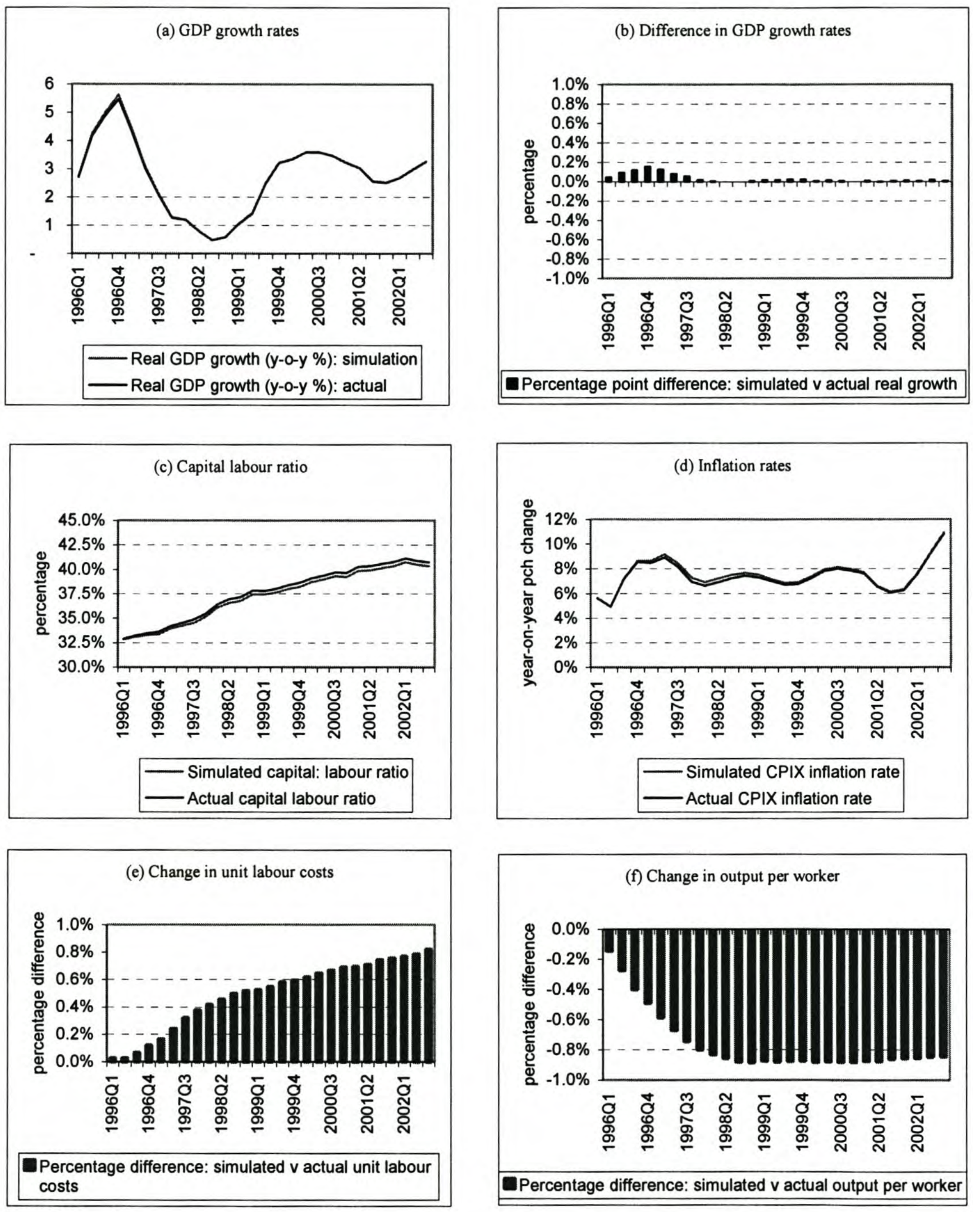

[48] The changes can be calculated using the estimated elasticities in Table 10-1 and Table 10-3, eq. 5. Output elasticity is 0,75. Output per worker falls initially by 0,75. Real wages thus change by -0,75 x

### 11.4. (c) Effect on other macroeconomic variables

Other macroeconomic variables behave as expected (see Figure 11-9). With the exception of the initial change in GDP growth, the growth rate is unchanged over the period. The capital labour ratio falls slightly (panel c). Inflation is fractionally higher (panel d), mainly as a result of unit labour costs rising over the period to 0,8 per cent higher than before. Output per worker also falls, for the same reason as before, *viz.* the rise in the number of workers (up 1,11 per cent) is greater than the rise in output (up 1 per cent).

0,73 = -0,55. Additional employment created is -0,55 * -0,67 = 0,37. Total creation of employment is thus 0,75 + 0,37 = 1,12.

**Figure 11-9**: Simulation C - Other economic variables

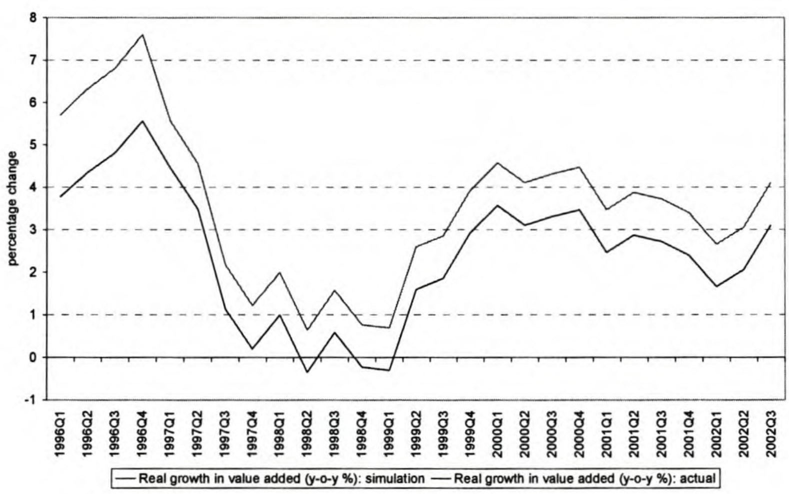


## 11.5. Simulation D: 1 per cent higher *growth* of output

### 11.5. (a) Nature of the shock

This simulation replicates the effect of a one per cent higher rate of growth over the period. The simulated and actual rates of growth are given in Figure 11-10. Over time GDP thus accumulates quicker and by the end of the period is 8,1 per cent higher.

**Figure 11-10**: Simulation D – Higher *rate* of output growth



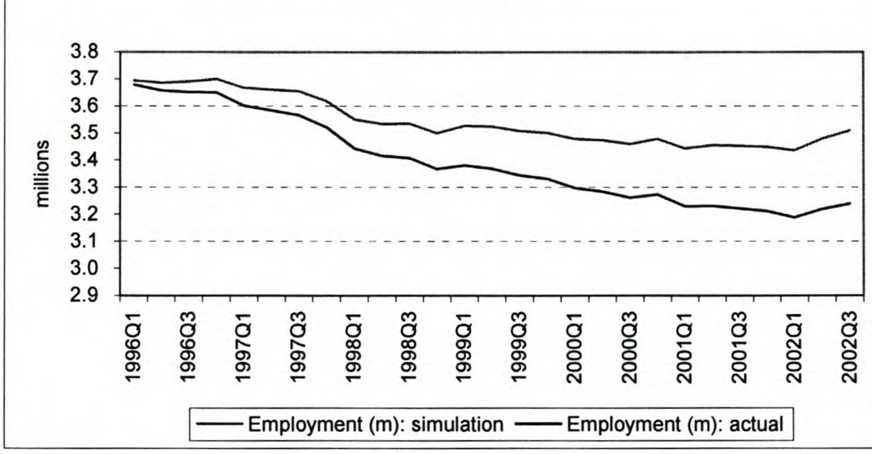

### 11.5. (b) Effect on employment

This simulation is different from the previous one in one very important aspect. As *growth* is persistently higher, it stands to reason that the level of GDP in the simulation will be significantly higher than in the baseline simulation by the end of the period (this divergence in the levels of GDP is shown in Figure 11-11). As a result, employment continues rising. By the end of the seven-year period employment is 8,3 per cent higher than in the baseline (see Figure 11-11). This is more than expected from directly interpreting the elasticities in the equation[49]. The reason is because output per worker falls (proportionately more output than workers). This puts downward pressure on wages (down 4,5 per cent over the period) and this leads to additional jobs[50].

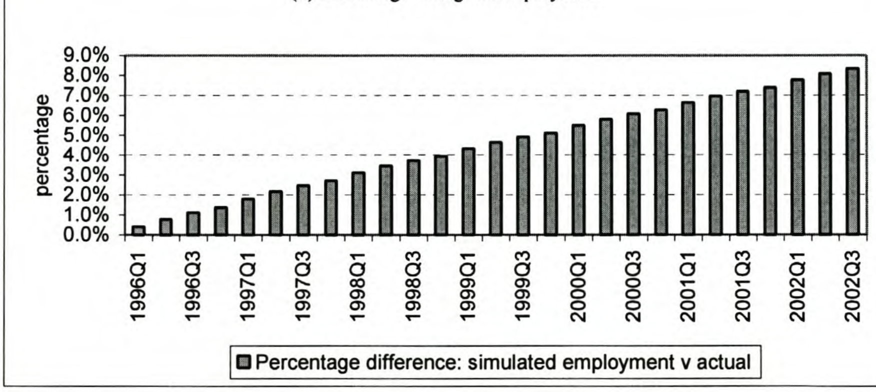
[49] This would have predicted a rise of 6,1% (0,75 x 8,1%)

[50] The additional rise in jobs is 3,1% (-4,5% x –0,67)

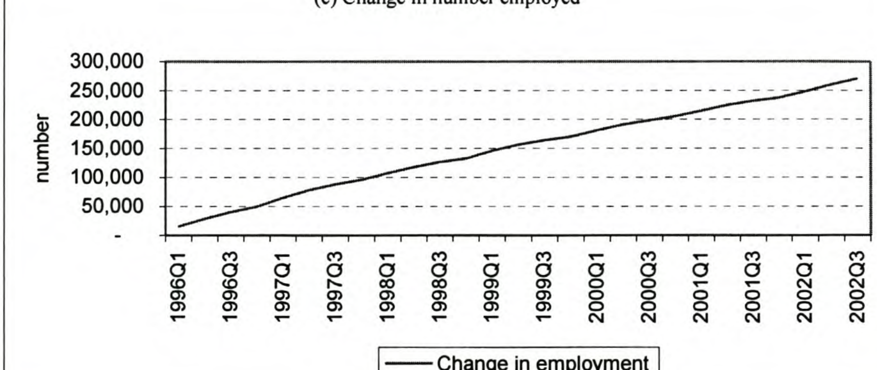
**Figure 11-11**: Simulation D – Effect on employment



(a) Employment levels



(b) Percentage change in employment

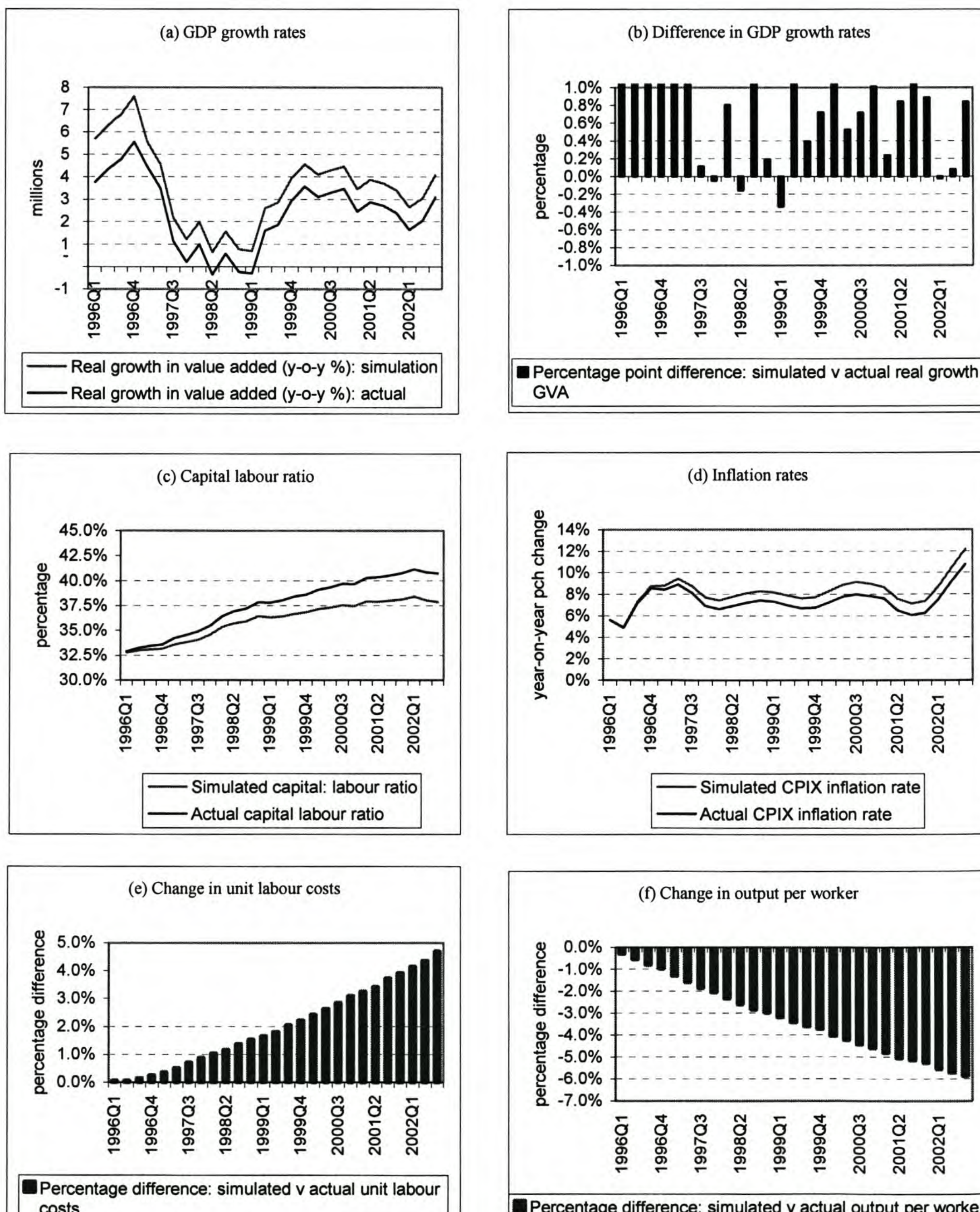


(c) Change in number employed

### 11.5. (c) Effect on other economic variables

The effect on other economic variables is as expected (Figure 11-12). The capital labour ratio (panel c) falls by 5 percentage points relative to before, as a result of higher levels of labour. Inflation (panel d) increases marginally as a result of a rise in unit labour costs (panel e), as a result of the rise in employment being greater than the rise in output. The flip side of this is that output per worker (panel f) declines.

**Figure 11-12**: Simulation D – Other economic variables

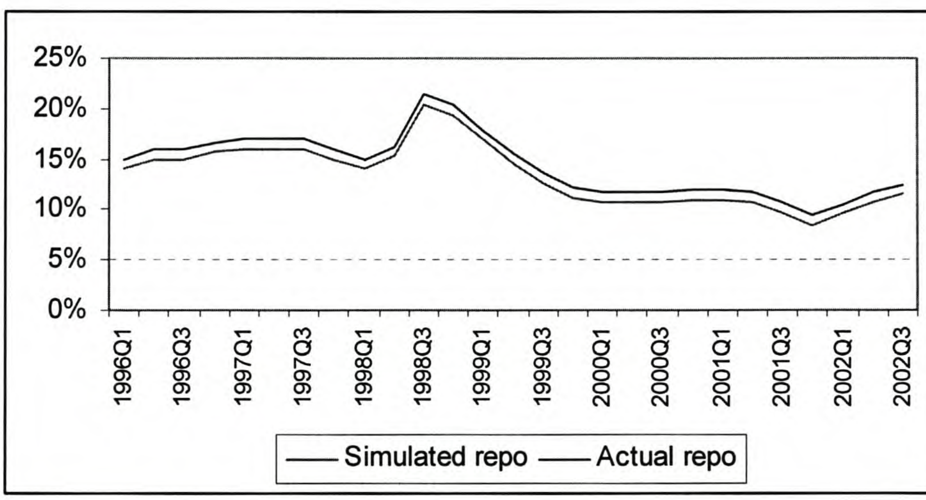


## 11.6. Simulation E: Looser monetary policy

### 11.6. (a) Nature of shock

The shock considers the impact of a one per cent fall in the central bank's overnight instrument rate[51]. Except for a brief period during 1997, this rate has been directly determined by the South African Reserve Bank. There have been frequent calls for it to be lowered in the interests of job-creation (see chapter 2).

**Figure 11-13**: Simulation E – Lower repo rate




### 11.6. (b) Effect on employment and other economic variables

The results are initially counter-intuitive: employment falls (see Figure 11-14 panel a and b), even though both the level of GDP and the rate of GDP growth rises (see Figure 11-15 panel a and b). The fall, however, can be explained by considering the effect on the broader economy. The bulk of the positive GDP effect comes about as a result of a rise in investment. Investment rises by 1,6 per cent by the end of the forecast period, higher than the accumulated rise in GDP (almost 0,6 per cent). The growth is thus investment-driven, unsurprising considering that the cost of capital has fallen. As a result, labour productivity rises by 1,1 per cent and unit labour costs by 1,2 per cent. This puts upward pressure on real wages. The relative prices of capital and labour thus adjust to favour capital twice over: not only is the cost of capital lower, but the cost of labour is also higher. Thus, employment falls and the fall is not offset by the increase in output.

[51] Initially the 'bank rate' and later the 'repo rate'.

**Figure 11-14**: Simulation E – Effect on employment

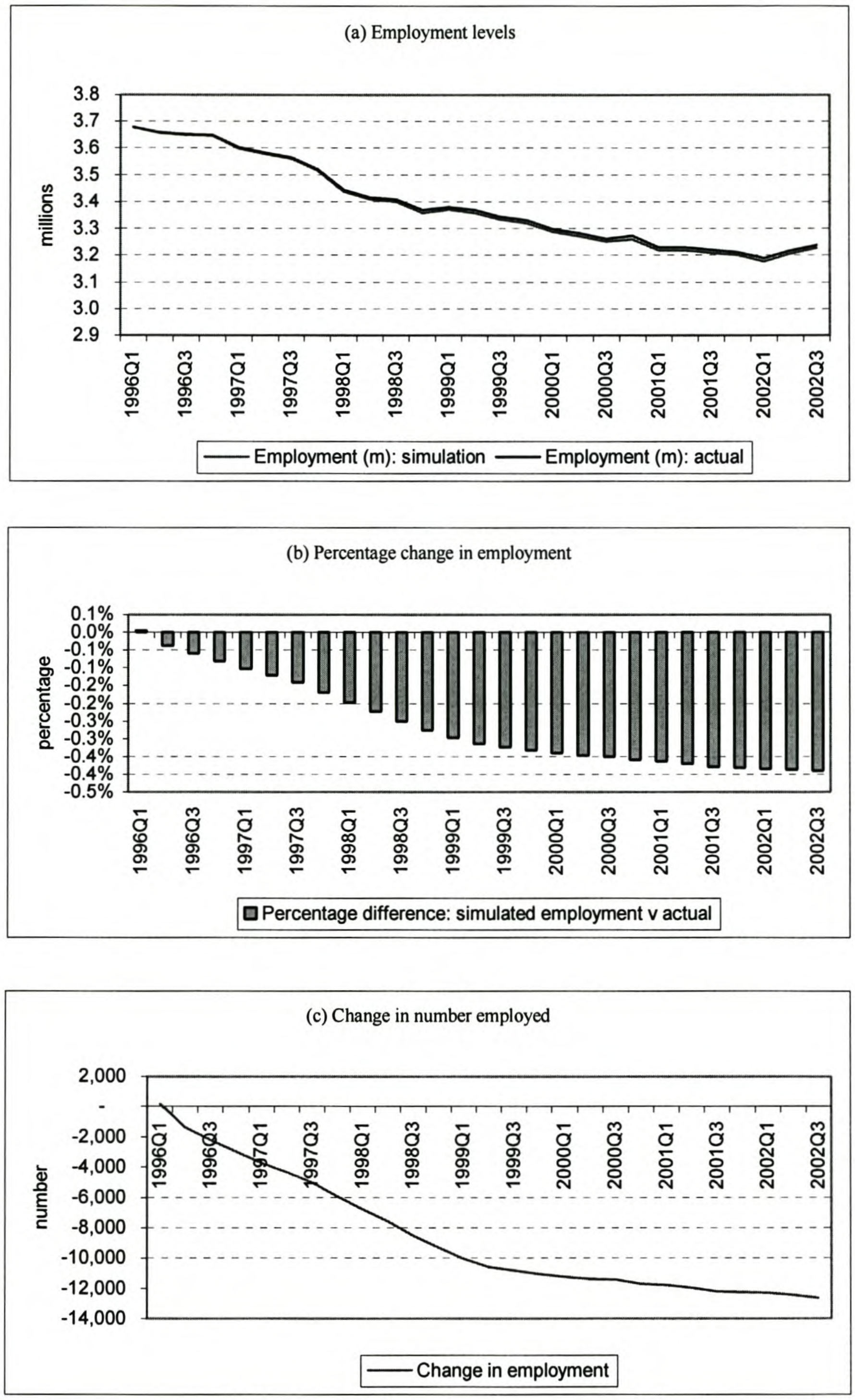
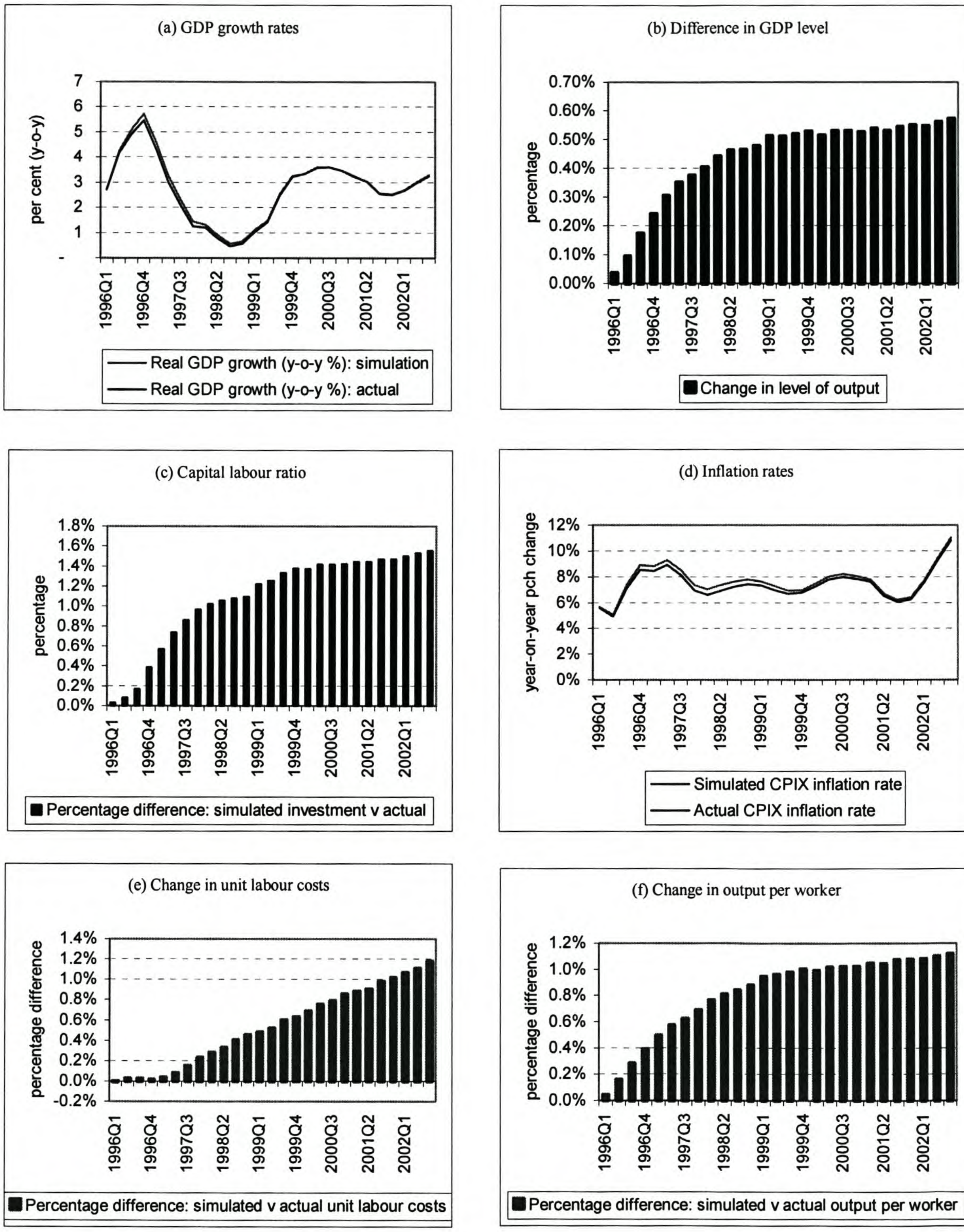


**Figure 11-15**: Simulation E – Other economic variables



## 11.7. Simulation F: Wage subsidy / Earned income tax credit

### 11.7. (a) Nature of the shock

The final simulation that is considered is a wage subsidy. It is important to realise that it comes with a disclaimer – an aggregate macroeconometric model is not the best tool to model the effects of a subsidy such as this. The reason is that this model, in particular, does not disaggregate skills levels. This allows no analysis of possible income distribution effects, nor does it allow the researcher to accurately model a targeted EITC. Two other analyses of this type of policy intervention are undertaken in Heintz and Bowles (1996) and Pauw (2003) respectively. The latter uses a dynamic computable general equilibrium model. This model used here has one significant advantage over that of Pauw: it is fully dynamic (a 'dynamic' CGE is simply a two-period model). Where the CGE is better for microeconomic effects, a macroeconometric model is better for macroeconomic effects (e.g. effects on interest rates, inflation and GDP growth). The results here should thus be read together with those of Pauw, and as far as possible the analysis here replicates his.

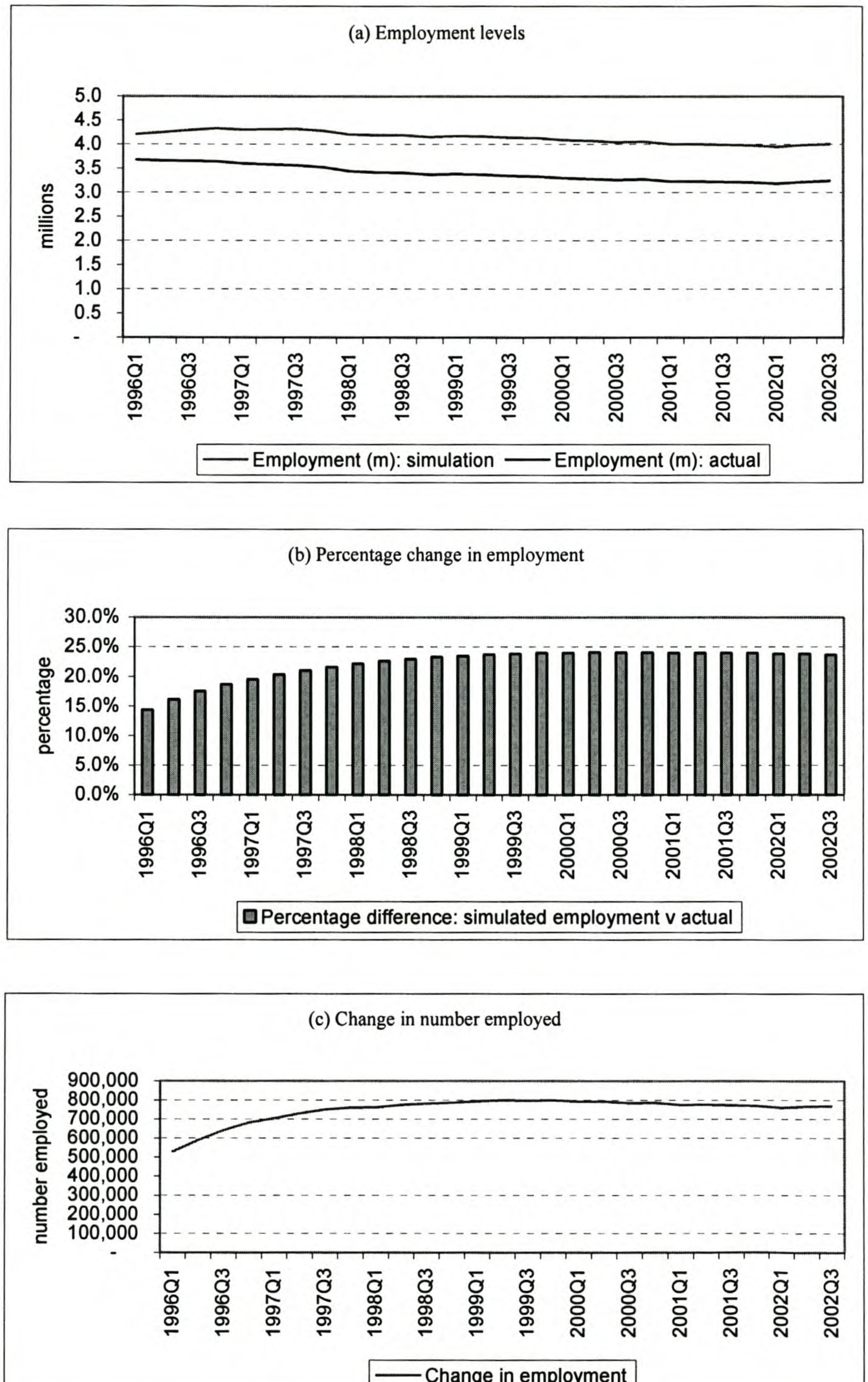
The simulation assumes a fiscal transfer per worker of 10 per cent of the wage. There is no means testing. Pauw (2003: 11) argues somewhat unconvincingly that it does not matter whether the transfer goes to employers or workers: if it goes to the employer, it will increase the demand for labour; if it goes to workers, it will increase the supply. With the enormous pool of unemployed people in South Africa, it is doubtful that supply is very elastic. For this reason the analysis here assumes the transfer is paid to the employer.

Pauw (2003) argues that, in any case, it is unimportant for the CGE model who receives the transfer. For a macro-model, however, this is a particularly important assumption. If the transfer goes to the employer, firm profitability will rise. This will in turn stimulate investment. If, however, it goes to workers, disposable income will rise, which will stimulate consumption (and encourage demand-pull inflation).

The shock is modelled as a R1 500 decline in real wages (1995 prices). The aggregate cost is modelled as being added to government expenditure. The specification of the model allows for two sub-scenarios: deficit-financing or balanced budget financing.

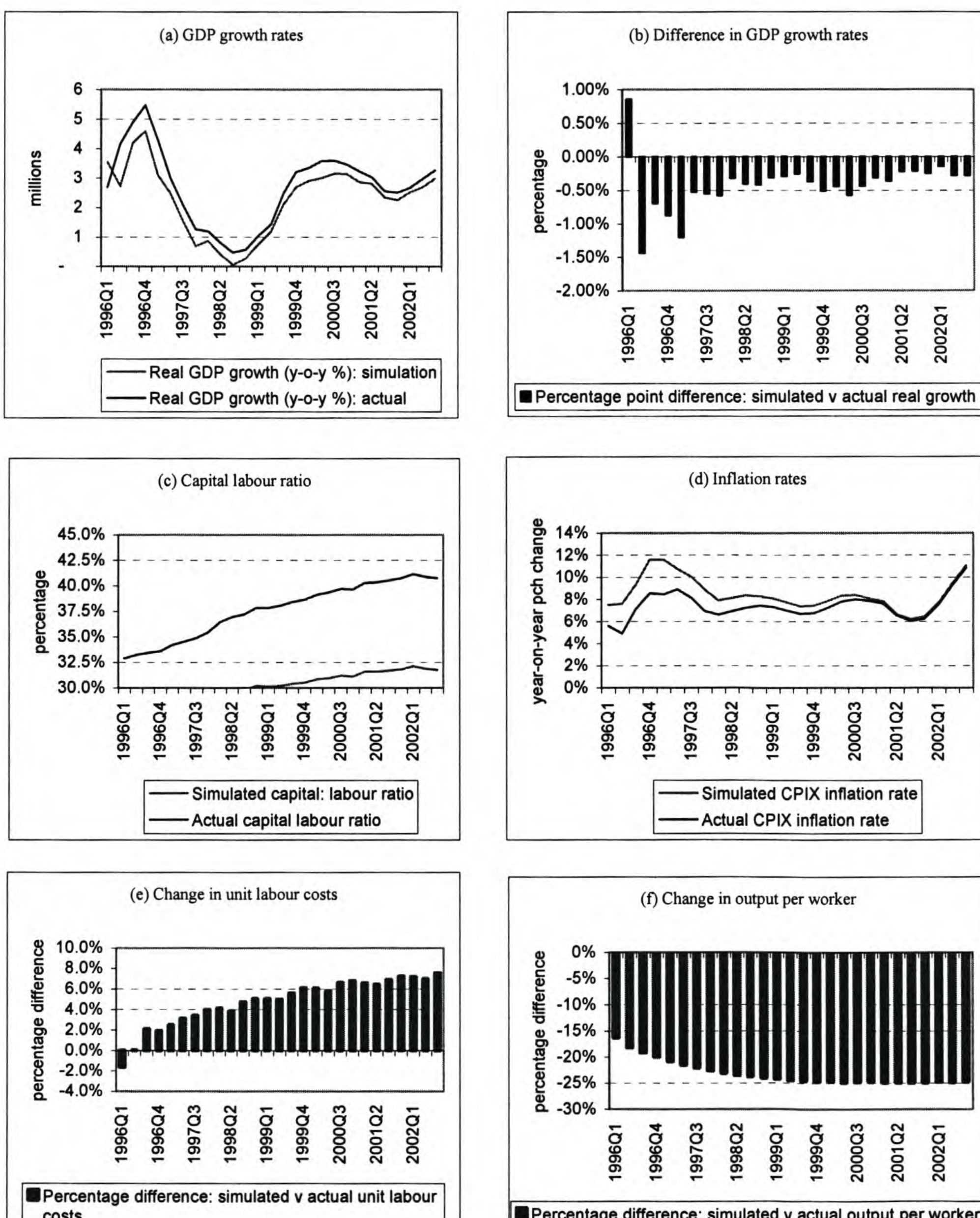
Unsurprisingly there is a significant increase in employment. As is shown in Figure 11-16 in panel (b), employment rises by approximately 25 per cent, which is nearly 800 000 jobs.

**Figure 11-16**: Simulation F – Effect on employment



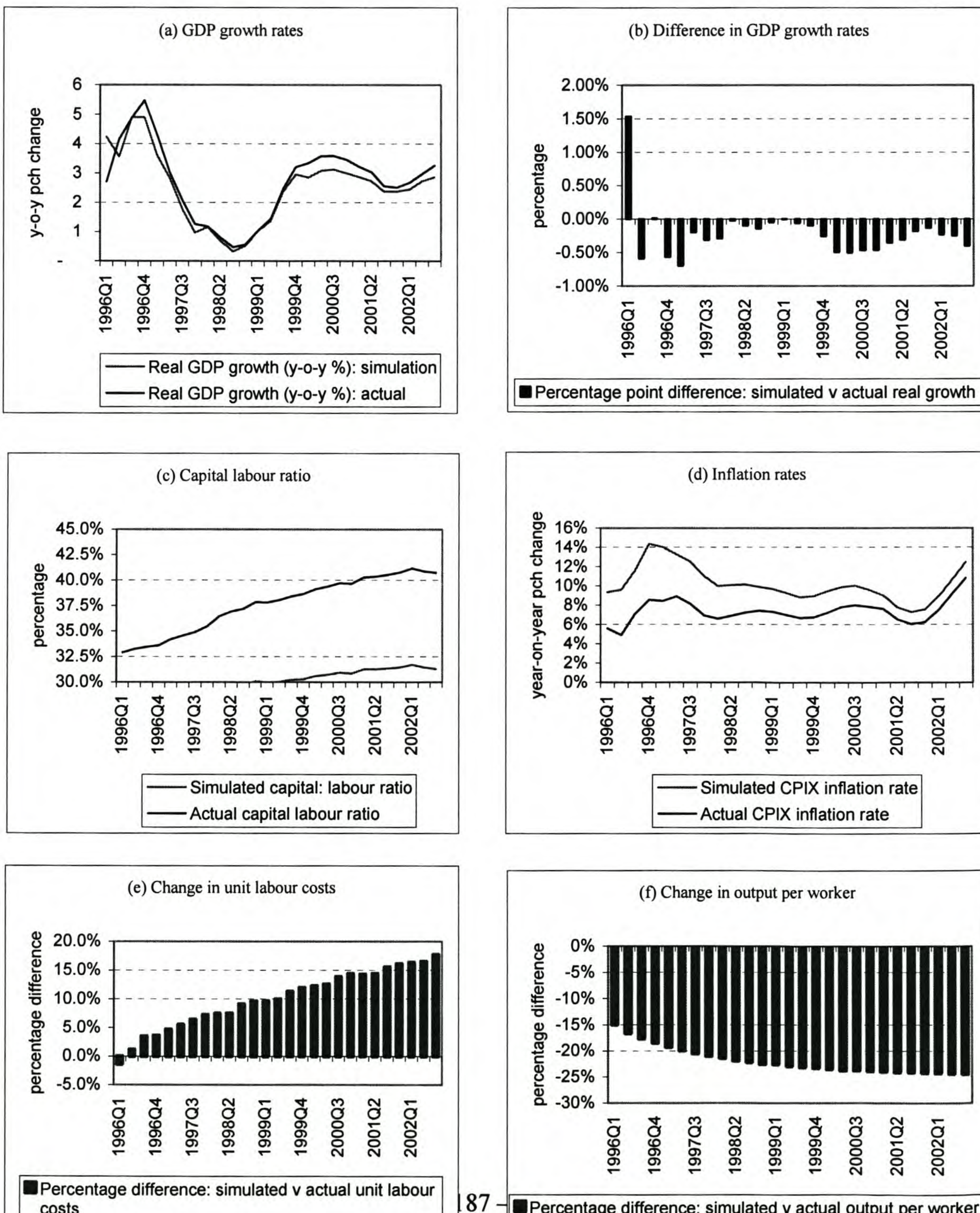
The cost of the subsidy is very large, approximately R35 billion. It is important to stress that this simulation assumes that government subsidies *all* workers 10 per cent of their wage – undoubtedly this is a much greater percentage than would be considered in terms of a targeted wage subsidy. As a result of the significant increase in government consumption spending and in the deficit, interest rates rise (both long rates and the policy rate as a result of the increase in inflation). Unit labour costs increase too, as a result of an increase in employment and a fall in output.

**Figure 11-17**: Simulation F – Other economic variables (deficit financed)



On the other hand, a balanced budget financing option shows that the effect on GDP growth is much more muted, even though there is still an increase in inflation. Once again there is a rise in unit labour costs and a fall in output per worker.

**Figure 11-18**: Simulation F – Other economic variables (balanced budget financed)



Overall, the wage subsidy scheme modelled here is a very effective job-creation tool, although reasonably expensive. This particular model cannot fully capture the distributional effects of a subsidy, and is somewhat incapable of capturing subtleties, e.g. if the subsidy were targeted to low income workers. Notwithstanding these limitations, the simulation shows that there is an overall gain to GDP and a net increase in jobs.

## 11.8. Conclusion

This chapter set out a number of model simulations to better understand how the labour market interacts with the broader macroeconomy. Six simulations were undertaken and the results are summarised in Table 10-2.

**Table 11-1**: Summary of simulations

| | *Size of shock* | *Average number of jobs created / lost over five years* | *Real GDP gained or lost over five years* |
|---|---|---|---|
| **Simulation A**<br>Fall in real wages | 1% | + 22 405 | + R 39,6 m |
| **Simulation B**<br>Constant real wages over five-year period | - | + 200 341 | - R 1 122 m |
| **Simulation C**<br>Rise in the level of output | 1% | + 33 253 | + R 1 051 m |
| **Simulation D**<br>Rise in the growth rate | 1% | + 149 947 | + R 5 113 m |
| **Simulation E**<br>Looser monetary policy | 1% | - 8 568 | + R 2 704 m |
| **Simulation F**<br>Wage subsidy | 10% | | |
| *Deficit financed* | | + 749 265 | + R 4 343 m |
| *Balanced budget financed* | | + 808 968 | + R 19 463 m |

Overall, the chapter suggests that job creation can be best achieved by policies that encourage wage moderation and economic growth, whilst supportive fiscal incentives – such as the mooted earned income tax credit scheme – would also lead to higher levels of employment.

# Chapter 12: Conclusion

*We shall not cease from exploration*
*And the end of all our exploring*
*Will be to arrive where we started*
*And know the place for the first time.*

T. S. Eliot. *Little Gidding* V.

## 12.1. Overview

On one level, the thesis presented a simplistic analysis of the labour market. The work returned to the basic theories underlying labour market economics. Beginning with the neoclassical approach, the thesis established that – as with any market – the demand for labour is derived from the demand for the goods and services that it produces. In addition, the relative price of labour matters, as do adjustment costs.

But the labour market is not any market – workers are not widgets. In reality, the price of workers is partly determined by the workers themselves. Particularly in countries with high unemployment there is an incentive, for example, for workers with jobs to band together and act in their own collective interest to keep outsiders out. From the firms' perspective, there may be an incentive to pay workers more – Stiglitz (1976: 186) succinctly notes that 'one well-paid worker may do what two poorly paid workers can do'. The labour market is also different from other markets in that there is no central 'market' and workers and job opportunities may take time to match.

These are completely logical explanations: they are both intuitively appealing and with some algebra can make mathematical sense too. Thus inability of a labour market to self-correct should not be surprising.

The empirical analysis gave some indications of where the problems are. It was found that:

- Efficiency wages do not appear to hold – in this thesis and elsewhere the empirical evidence suggests that although higher productivity causes higher wages, the converse is not true;
- Union activity does cause higher real wages, at least in the short run;

- Higher real wages cause employment to fall. A one per cent rise in real wages is expected to reduce employment by approximately two-thirds of a per cent;
- Interestingly, a fall in the user cost of capital, through for example a fall in the interest rate, causes the demand for labour to decrease due to labour becoming less attractive.

Overall, the empirical work supports the findings of the theoretical analysis. Not only do neoclassical factors, such as output and relative prices matter, but structural factors, such as unionisation, are important too.

## 12.2. Shortcomings of this analysis and pointers for future work

With the exception of Fallon and Lucas (1998) and the related papers, one issue that the South African microeconomic literature has not developed is that of segmented labour markets. It is admittedly a shortcoming of this thesis too. As the data improves, further work in this area would be a welcome addition to understanding issues around labour mobility and skills differentials. Some background work undertaken for this thesis showed that wage and output elasticities differ between industries and sectors (cf. Fallon and Lucas 1998). A further extension of the work presented here might look at whether or not the market for different skills groups functions differently. It is not beyond the realm of possibility that skills shortages (such as discussed in Van der Berg 2001) in certain sectors (e.g. finance) may bid up the average wage whilst skill surpluses (e.g. in mining) may depress the average wage. Given historical inequities, it is not clear that labour is mobile between sectors (an implicit assumption of the neoclassical model).

Geographic labour mobility is also an area of research that needs to be explored. This is not only geographic in the sense of provinces, but also introduces what the literature terms 'spatial' – i.e. how cities and urban areas are structured. A rare South African paper in this tradition, Selod and Zenou (2001), explores how the market for education is affected by the (somewhat bizarre) structure of South African cities. Even the 'urbanised' unemployed live literally hundreds of kilometres way from work opportunities[52]. Kingdon and Knight (2001) have considered how this may affect reservation wages.

High unemployment is not only an urgent social challenge, but an urgent intellectual one too. The thesis also finds that comments made by Donaldson (2001: 3) are still largely true:

> we have manifestly failed to create sufficient jobs in our economy, despite the improved growth performance since the 1992 recession. Having grown accustomed to this failure, we have allowed its urgency to fade from view.

Although there has been some work on the macroeconomics of the labour market – most notably by Fedderke and Marrioti (2002) and Wakeford (2003) – the literature is still underdeveloped. This is unfortunate considering that this is South Africa's key policy and intellectual challenge.

Employment data are still an important concern. As has been highlighted in chapter 9, there are many sources of data that are as yet unexplored – the PMI employment index, business confidence indices and so forth could prove useful for short-term policy analysis.

The analysis was also limited by only considering the demand for labour. The supply of labour is the other half of the analysis and it is important to consider how this influences labour market outcomes.

## 12.3. Policy directions

Economic policy is still at the 'analytical crossroads' that Donaldson (2001) refers to – it is a crossroads because it touches at the heart of the government's policy approach in the future. The literature must become more policy relevant: that is more focussed on asking key simple questions: what policies are required for jobs, economic opportunity and sustainable growth? This thesis highlighted the research of some of the greatest names in economics – among them Keynes, Blanchard, Summers, Solow, Stiglitz and Lucas – who have applied their minds to solving a central challenge in macroeconomics: preventing the recurrence of the extraordinary high unemployment of the Great Depression.

[52] Urbanised in the sense that they have migrated from deep rural areas.

The main current in the thesis was that of the competing paradigms that are used to analyse the issue: neoclassical versus structuralist; interventionist versus non-interventionist. These paradigms are, as Stals (1997) has pointed out, often mere knee-jerk ideological points of view – usually reflecting not academic rigour but rather protecting vested interests.

Georg Hegel, a German philosopher, proposed that ideas develop in three stages: thesis, antithesis and synthesis. Given the importance of the unemployment problem, the time has come to find an intellectual synthesis and to move forward.

The findings notwithstanding, the thesis attempted to contribute a framework for analysing the issue: a framework that is not at the mercy of ideology or self-interest. The central message of the thesis is that unemployment is indeed a complex problem, with many interesting, and sometimes confusing, subtleties. Ultimately, by understanding these unique subtleties and intricacies, one is in a better position to address the problem.

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# Appendix: Data Sources and Descriptive Statistics

| | Description | Abbrev | Source | Code / Calc | Mean | Median | Maximum | Minimum |
|---|---|---|---|---|---|---|---|---|
| 1 | Capacity utilisation | YCU | Calc | y1/ypot1*100 | 99.92 | 99.83 | 102.92 | 96.11 |
| 2 | CPIX - CPI excluding mortgage interest (1995 = 100) | PCPIX | StatsSA | vpn40007 | 92.04 | 91.34 | 168.64 | 31.88 |
| 3 | Deflator: Final household consumption (1995 = 100) | PC | Calc | ce/ce1*100 | 91.28 | 90.69 | 164.48 | 30.56 |
| 4 | Dummy variable: 1990q1 =1; 0 otherwise | DUM90Q1 | Calc | 1990q1 =1; 0 otherwise | 0.01 | - | 1.00 | - |
| 5 | Dummy variable: 1996q1 =1; 0 otherwise | DUM96Q1 | | 1998q1 =1; 0 otherwise | 0.01 | - | 1.00 | - |
| 6 | Dummy variable: 1998q1 =1; 0 otherwise | DUM98Q1 | Calc | 1998q1 =1; 0 otherwise | 0.01 | - | 1.00 | - |
| 7 | Employment: Government | NETQG | SARB | RBQN; rb7000l | 1.51 | 1.51 | 1.60 | 1.39 |
| 8 | Employment: Private (Formal, non-agricultural) | NETQP | SARB | netqt-netqg | 3.76 | 3.75 | 4.25 | 3.19 |
| 9 | Employment: Total (Formal, non-agricultural) | NETQT | SARB | RBQN; rb7009l | 5.28 | 5.34 | 5.76 | 4.63 |
| 10 | Gross value added at factor cost | YF | Calc | (y+gsub-ti) | 467 738.00 | 428 866.00 | 976 417.00 | 124 827.00 |
| 11 | Labour-productivity: Private sector | LPRODP | Calc | ywbp/(y1-gc1) | 117 850.30 | 108 920.30 | 164 895.20 | 89 302.15 |
| 12 | Measure for Openness of the economy (4q moving average) | YLIB1 | Calc | @movav(((e1 + m1) / y1 * 100) , 4) | 40.59 | 39.46 | 49.65 | 30.47 |
| 13 | Number of mandays lost in year | MANDAYSLOST | Andrew Levy Consultants | 1998q1 =1; 0 otherwise | 445 604.60 | 295 000.00 | 4 648 135.00 | 1.00 |
| 14 | Real wage rate: Private | WRPR | SARB | (wrp/(pc/100)) | 54 515.19 | 51 170.24 | 69 207.77 | 45 075.52 |
| 15 | User cost of capital (Real after tax) | UCK | Calc | (1/(1-tcr))*(fgovl-ppcpix)+(100*idtr) | 10.66 | 11.73 | 18.11 | 0.60 |
| 16 | Wage bill: Private (Formal non-agricultural sector) | YWBP | SARB | ywbt-ywbg | 188 609.90 | 173 558.00 | 363 508.00 | 56 703.00 |
| 17 | Wage rate: Private | WRP | SARB | ywbp/lep | 52 847.09 | 46 398.81 | 112 222.70 | 13 773.94 |

| | Continued | Std. Dev. | Skewness | Kurtosis | Jarque-Bera | Probability | Observations |
|---|---|---|---|---|---|---|---|
| 1 | Capacity utilisation | 1.52 | -0.06 | 2.65 | 0.39 | 0.82 | 67.00 |
| 2 | CPIX - CPI excluding mortgage interest (1995 = 100) | 39.33 | 0.15 | 1.86 | 3.90 | 0.14 | 67.00 |
| 3 | Deflator: Final household consumption (1995 = 100) | 39.83 | 0.08 | 1.79 | 4.18 | 0.12 | 67.00 |
| 4 | Dummy variable: 1990q1 =1; 0 otherwise | 0.12 | 8.00 | 65.02 | 11 451.25 | - | 67.00 |
| 5 | Dummy variable: 1996q1 =1; 0 otherwise | 0.12 | 8.00 | 65.02 | 11 451.25 | - | 67.00 |
| 6 | Dummy variable: 1998q1 =1; 0 otherwise | 0.12 | 8.00 | 65.02 | 11 451.25 | - | 67.00 |
| 7 | Employment: Government | 0.06 | -0.26 | 1.90 | 4.10 | 0.13 | 67.00 |
| 8 | Employment: Private (Formal, non-agricultural) | 0.35 | -0.16 | 1.65 | 5.42 | 0.07 | 67.00 |
| 9 | Employment: Total (Formal, non-agricultural) | 0.36 | -0.43 | 1.91 | 5.42 | 0.07 | 67.00 |
| 10 | Gross value added at factor cost | 247 068.20 | 0.37 | 1.95 | 4.60 | 0.10 | 67.00 |
| 11 | Labour-productivity: Private sector | 24 429.55 | 0.61 | 1.96 | 7.17 | 0.03 | 67.00 |
| 12 | Measure for Openness of the economy (4q moving average) | 6.62 | 0.00 | 1.33 | 7.76 | 0.02 | 67.00 |
| 13 | Number of mandays lost in year | 658 961.40 | 4.36 | 26.49 | 1 752.78 | - | 67.00 |
| 14 | Real wage rate: Private | 8 174.61 | 0.58 | 1.81 | 7.72 | 0.02 | 67.00 |
| 15 | User cost of capital (Real after tax) | 4.23 | -0.37 | 2.21 | 3.25 | 0.20 | 67.00 |
| 16 | Wage bill: Private (Formal non-agricultural sector) | 91 328.55 | 0.26 | 1.84 | 4.54 | 0.10 | 67.00 |
| 17 | Wage rate: Private | 30 082.14 | 0.45 | 1.94 | 5.36 | 0.07 | 67.00 |