# CHAPTER 8

PRICE SETTING IN A NEOCLASSICAL FRAMEWORK

8.1 INTRODUCTION

The key decision for firms operating in a neoclassical, i.e. profit-maximising or cost-minimising framework is where to set their prices.

The purpose of this chapter is to develop a pricing structure for the neoclassical supply-side model. This offers the additional advantage of being able to explain the high inflation levels the South African economy has been plagued with since 1970 (see figure 8.1). For purposes of consistency, the Layard-Nickell approach, utilised in chapter 7 to model wages and employment, is again employed. It is based on the estimation of an aggregate cost function and, as explained before, it is utilised in a slightly different way in this study (see chapter 7). However, the approach still entails the joint derivation and estimation of factor demand and price equations, ensuring consistency in the neoclassical framework.

Figure 8.1   Inflation in South Africa: 1970-1995

— Consumption prices ---- Production prices
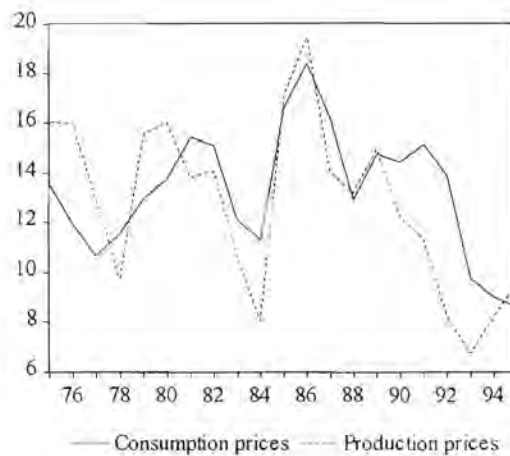
8.2 THEORETICAL FRAMEWORK

In a neoclassical profit-maximising framework with imperfect market competition, such as the one suggested by Layard and Nickell (1985, 1986; Nickell 1988), firms set prices as a mark-up on the marginal cost of production, proxied by average or unit costs (Burda and Wyplosz 1993: 256).

$$P^p = m * AC \qquad \text{where} \qquad m = \frac{1}{1 - 1/\eta} > 1; \qquad m' \geq 0 \qquad (8.1)$$

with P^p production prices, m the price mark-up, AC average or unit cost of production and η price elasticity of demand.

The mark-up (m) depends on the sensitivity of the market to price changes, measured by the price elasticity of demand. As it is natural to think of m as being influenced by the short-run demand position, it may be specified in terms of a demand pressure variable, such as expected demand relative to normal output (Nickell 1988):

$$m = m(Y^{ed} / Y^*)$$ (8.2)

Although the cost of production includes both labour and capital costs, it is standard practice to base a model of price-setting on normal unit (average) costs, where "normal" in this context refers to labour costs only, excluding the cost of capital.[1]

Assuming normal unit costs (similar to Layard and Nickell), average cost of production may be specified in terms of (1) changes in nominal wage rates relative to labour productivity, (2) cyclical demand pressures such as deviations in actual unemployment rates from the equilibrium rate of unemployment, rates of capacity utilisation, etc., and (3) exogenous supply shocks (Burda and Wyplosz 1993: 243-248).

Layard and Nickell go a step further by expanding the price equation to incorporate expected competitors' prices, yielding a price-setting equation of the form:

$$P^p / W = h(P^p / P^e) m(Y^{ed} / Y^*) g(Y^* / \alpha L)$$ (8.3)

where W is nominal wages inclusive of employers' labour taxes, P^p / P^e is production (value-added) relative to expected prices and $Y^* / \alpha L$ is the normal labour productivity (Nickell 1988: 203-204).

Consumer prices (P^c), which are directly related to production prices, may now be specified as:

$$P^c = f(P^p, t', P^m)$$ (8.4)

where t' is indirect taxes and P^m import prices on consumption goods.

8.3   ESTIMATION RESULTS

In this section, models of production and consumption prices are proposed, estimated and validated by utilising the Engle and Yoo cointegration technique and a battery of diagnostic tests and evaluation procedures. The specifications are based on a strategy of mark-up pricing in a profit-maximising framework.

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[1]   This approach is followed by Layard and Nickell and differs from that followed by (for example) the OECD, where the cost of capital is also included in the specification of price equations (Helliwell 1985; Turner et al. 1996).

8.3.1 The theoretical model

The Layard-Nickell framework of mark-up pricing is used as the basis to model price-setting behaviour in South Africa. Whereas Layard and Nickell assume normal unit costs, this study has opted for an approach where unit capital costs are also included in the price equation. Long-run production or value-added prices P^p are therefore specified and estimated as:

$$P^p = f((W / product), r)$$
$$\quad\quad + \quad\quad\quad +$$

where W is the nominal wage rate, *product* is labour productivity and r is nominal user-cost-of-capital (Appendix 7). A measure for capacity utilisation (cu) is included in the short-run specification of the model to capture potential demand pressures.

Based on the theoretical exposition in the previous section, consumption prices (P^c) are specified as:

$$P^c = f(P^p, P^m, GDE/GDP)$$

where GDE/GDP (gross domestic expenditure relative to gross domestic production in nominal terms, i.e. excess demand) creates a link with the demand side and captures any demand pressure effect.

In order to distinguish between the contribution of the rand exchange rate relative to the contribution of true prices of import goods, import prices in rand (P_R^m) are included as:

$$P^m = P_R^m = P_\$^m * R/\$$$

where $P_\$^m$ is import prices in dollar and $R/\$$ the rand/dollar exchange rate, South Africa's leading exchange rate.

Consumption prices (P^c) are therefore estimated in the form:[2]

$$P^c = f(P^p, P_\$^m, R/\$, GDE/GDP)$$
$$\quad\quad + \quad + \quad + \quad\quad\quad +$$

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[2] Restrictions had to be placed on the coefficients of P^p and $P_\$^m$ due to obvious problems in the data series.

8.3.2   The data

The data-generating processes, as well as an explanation of the methodology, are provided in Appendix 7. Appendices 8 and 9 present an explanatory list and graphical representation of variables utilised in both the long-run cointegration and short-run error correction model.

8.3.3   Production prices

(i)   *The estimation results of the cointegration equation*

In estimating the long-run relationship empirically specified in the previous section for production or value-added prices, the cointegration results of table 8.1 were obtained, with an Engle-Granger test statistic of –3.11.

Table 8.1   Cointegration equation: Production price index

Dependent Variable: ln_ppi
Method: Least Squares
Sample(adjusted): 1970 1995
Included observations: 26 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ln_ucc2_nom	0.267628	0.113043	2.367486	0.0267
ln_w_prod	0.605172	0.105318	5.746112	0.0000
c	-4.146606	0.880478	-4.709497	0.0001
R-squared	0.998734	F-statistic		9071.626
Adjusted R-squared	0.998624	Prob(F-statistic)		0.000000

An illustration of the stationary residuals is provided in figure 8.2.

Figure 8.2   Residuals: production price index (ln_ppi)
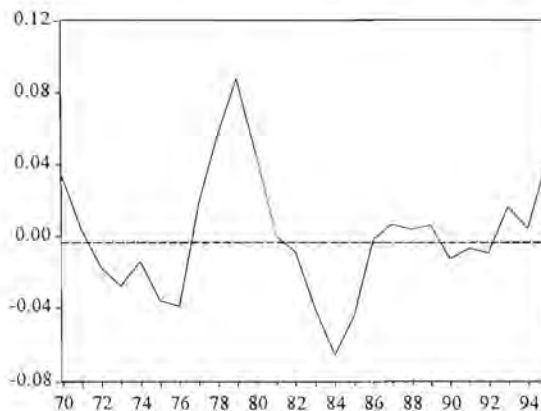
(ii)   *The short-run dynamics: error correction model (ECM)*

The short-run dynamics of the model are reported in table 8.2.

Table 8.2   **Error correction model: Production price index**

Dependent Variable: Δ(ln_ppi)
Method: Least Squares
Date: 09/20/99   Time: 02:45
Sample(adjusted): 1972 1995
Included observations: 24 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
residual(-1)	-0.283469	0.114908	-2.466917	0.0233
ln_cu(-2)	0.012082	0.002748	4.396891	0.0003
Δ(ln_interposind)	-0.127054	0.028129	-4.516836	0.0002
Δ(sanction_dum)	0.032431	0.012571	2.579837	0.0184
Δ(ln_w_prod)	0.351462	0.086008	4.086365	0.0006
R-squared	0.782778	F-statistic		17.11707
Adjusted R-squared	0.737048	Prob(F-statistic)		0.000004
S.E. of regression	0.016722			

The dynamic adjustment to the long-run equilibrium is explained, in addition to the long-run explanatory variables, by a measure for capacity utilisation (*ln_cu*) capturing the effects of demand pressure, a set of international factors (*ln_interposind*) emphasising the role of the degree of openness of the South African economy on domestic prices and a dummy variable for economic sanctions (Appendix 7).

The estimation results are plotted in figure 8.3.

Figure 8.3   **Actual, fitted and residual values of ln_ppi**

Residual ⋯⋯ Actual ----Fitted
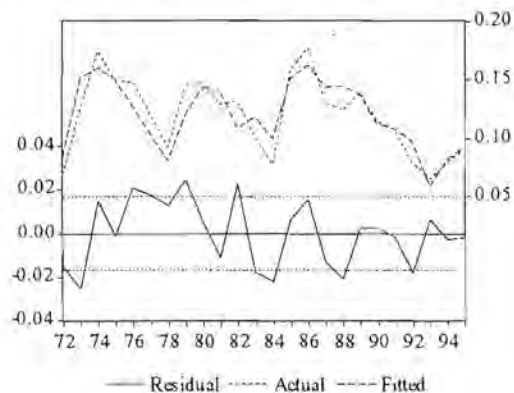
(iii)   *Diagnostic testing*

The estimated function is statistically well-behaved and passes the full set of diagnostic tests. The results are reported in table 8.3.

Table 8.3   **Diagnostic tests: Production price index (ln_ppi)**

Purpose of test	Test	d.f.	Test statistic	Probability
Normality	Jarque-Bera	JB(2)	1.338548	[0.521080]
Homoscedasticity	ARCH LM	$nR^2(1)$	0.086306	[0.768927]
Homoscedasticity	White	$nR^2(10)$	9.181205	[0.514997]
Serial correlation	Breusch-Godfrey	$nR^2(2)$	0.616509	[0.734728]
Serial correlation	Lung Box Q	Q(12)	9.132500	[0.692000]
Misspecification	Ramsey Reset	LR(2)	0.272135	[0.872784]
Parameter stability	Recursive estimates	Indicative of stability		

(iv)   *Cointegration correction and adjusted coefficients*

After the estimation of the error correction model, the third-step cointegration correction was carried out (table 8.4) to determine the adjusted coefficients and *t*-values (table 8.5).

Table 8.4   **Engle-Yoo third-step estimation: Production price index (ln_ppi)**

Dependent Variable: residual_ecm
Method: Least Squares
Sample(adjusted): 1972 1995
Included observations: 24 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic
(0.283469)*ln_ucc2_nom	-0.006231	0.008910	-0.699308
(0.283469)*ln_w_prod	-0.001954	0.003043	-0.642090

Table 8.5   **Cointegration correction: Production price index (ln_ppi)**

Variable	Adjusted Coefficient	Adjusted t-Statistic
ln_ucc2_nom	0.261397	29.337486
ln_w_prod	0.603218	198.23135

A dynamic simulation of the estimated model resulted in figure 8.4.

Figure 8.4   Actual and fitted values of ln_ppi
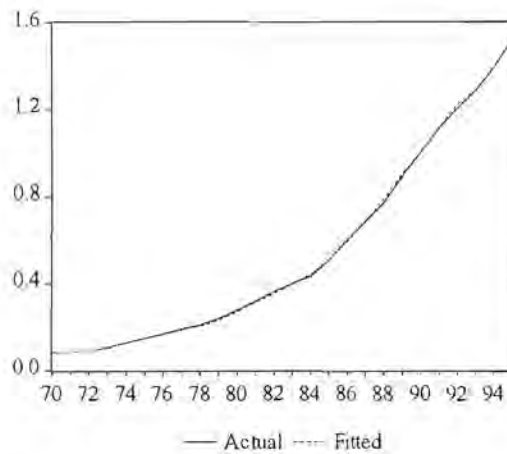
— Actual ---- Fitted

The associated simulation error statistics,[3] all indicative of a good fit, are reported in table 8.6.

Table 8.6   Simulation error statistics of production
price index

Actual v Fitted : ln_ppi	
Root Mean Squared Error	0.014879
Mean Absolute Error	0.012546
Mean Absolute Percentage Error	1.993426
Theil Inequality Coefficient	0.006033
Bias Proportion	0.000000
Variance Proportion	0.020916
Covariance Proportion	0.979084

8.3.4   Consumption prices

(i)   *The estimation results of the cointegration equation*

The equilibrium estimation results are reported in table 8.7, with the associated Engle-Granger test statistic of −2.84, indicative of a cointegrated long-run relationship.
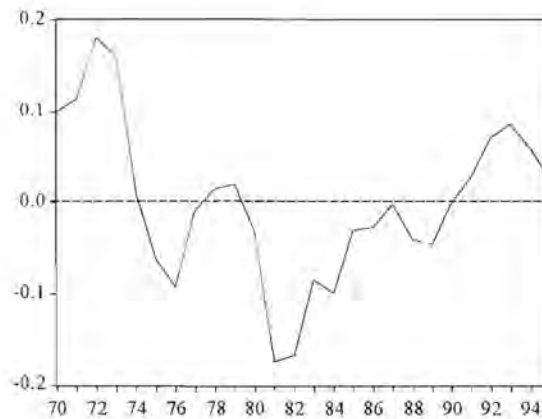
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[3]   See Appendix 2.

Table 8.7   Cointegration equation: Consumer price index

Dependent Variable: ln_vpi
Method: Least Squares
Sample(adjusted): 1970 1995
Included observations: 26 after adjusting endpoints
ln_vpi = 0.7*ln_ppi + 0.3*ln_pz$ + c(1)*ln_exces_dem_cp + c(2)*ln_r$
+ c(3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
c(1)	1.505656	0.463474	3.248629	0.0035
c(2)	0.334323	0.031960	10.46080	0.0000
c(3)	-1.478081	0.153974	-9.599528	0.0000
R-squared	0.991513	F-statistic		1343.568
Adjusted R-squared	0.990775	Prob(F-statistic)		0.000000

A plot of the stationary residuals is illustrated in figure 8.5.

Figure 8.5   Residuals: Consumer price index (ln_vpi)

(ii)   *The short-run dynamics: error correction model (ECM)*

The estimation results of the error correction model are reported in table 8.8.

In addition to the long-run explanatory variables, a monetary inflationary variable, the prime overdraft rate (ln_prime_rate) contributes to the explanation of the short-run variation in consumer prices.

Table 8.8   Error correction model: Consumer price index

Dependent Variable: $\Delta(\ln\_vpi)$
Method: Least Squares
Sample(adjusted): 1973 1995
Included observations: 23 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
residual(-1)	-0.298653	0.067905	-4.398079	0.0023
$\Delta(\ln\_ppi)$	0.454890	0.106073	4.288464	0.0027
$\Delta(\ln\_ppi(-1))$	0.847749	0.209674	4.043178	0.0037
$\Delta(\ln\_ppi(-2))$	-0.258956	0.124184	-2.085253	0.0705
$\Delta(\ln\_exces\_dem\_cp)$	0.592261	0.120751	4.904811	0.0012
$\Delta(\ln\_exces\_dem\_cp(-2))$	-0.392387	0.075653	-5.186646	0.0008
$\Delta(\ln\_prime\_rate)$	-0.166641	0.031384	-5.309776	0.0007
$\Delta(\ln\_prime\_rate(-1))$	0.070108	0.014600	4.801921	0.0014
$\Delta(\ln\_vpi(-1))$	-0.498413	0.211873	-2.352410	0.0465
$\Delta(\ln\_pz\$)$	-0.150988	0.065846	-2.293063	0.0510
$\Delta(\ln\_pz\$(-1))$	-0.472941	0.115748	-4.085948	0.0035
$\Delta(\ln\_pz\$(-2))$	0.089553	0.027964	3.202507	0.0126
$\Delta(\ln\_r\$)$	-0.104279	0.054366	-1.918108	0.0914
$\Delta(\ln\_r\$(-1))$	-0.440339	0.116080	-3.793407	0.0053
c	0.122906	0.021777	5.643762	0.0005

R-squared	0.969542	F-statistic	18.18992
Adjusted R-squared	0.916241	Prob(F-statistic)	0.000156
S.E. of regression	0.006670		

Figure 8.6 illustrates the overall fit of the estimated function.

Figure 8.6   Actual, fitted and residual values of ln_vpi
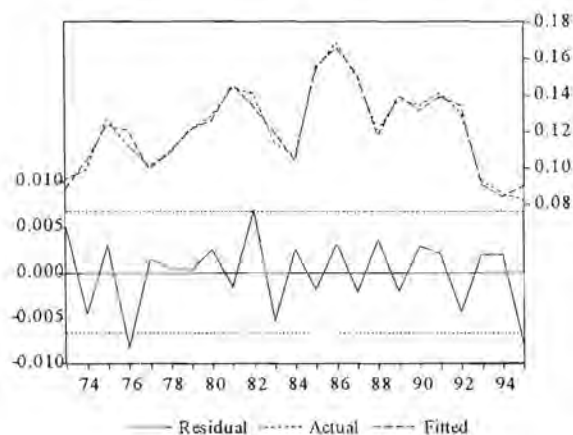
(iii)   *Diagnostic testing*

The estimated function was subjected to rigorous diagnostic testing. The results, indicative of a statistically well-behaved function, are reported in table 8.9.

Table 8.9   **Diagnostic tests: Consumer price index (ln_vpi)**

Purpose of test	Test	d.f.	Test statistic	Probability
Normality	Jarque-Bera	JB(2)	1.439940	[0.486767]
Homoscedasticity	ARCH LM	$nR^2(1)$	0.103165	[0.748064]
Homoscedasticity	White	Insufficient number of observations		
Serial correlation	Breusch-Godfrey	$nR^2(2)$	7.836501	[0.021218]
Serial correlation	Lung Box Q	Q(12)	19.59300	[0.075000]
Misspecification	Ramsey Reset	LR(2)	2.183798	[0.335579]
Parameter stability	Recursive estimates	Indicative of stability		

(iv)   *Cointegration correction and adjusted coefficients*

The estimation results of the Engle and Yoo cointegration correction, as well as the resulting adjusted coefficients and *t*-values are reported in tables 8.10 and 8.11 respectively.

Table 8.10   **Engle-Yoo third-step estimation: Consumer price index (ln_vpi)**

Dependent Variable: residual_ecm
Method: Least Squares
Sample(adjusted): 1973 1995
Included observations: 23 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic
(0.298653)*ln_exces_dem_cp	-0.074497	0.075732	-0.983690
(0.298653)*ln_r$	-0.000642	0.000839	-0.765107

Table 8.11   **Cointegration correction: Consumer price index (ln_vpi)**

Variable	Adjusted Coefficient	Adjusted t-Statistic
ln_exces_dem_cp	1.431159	18.897679
ln_r$	0.333681	397.71275

The dynamic simulation results as well as the statistical confirmation of the goodness-of-fit of the model are presented by figure 8.7 and table 8.12 respectively.
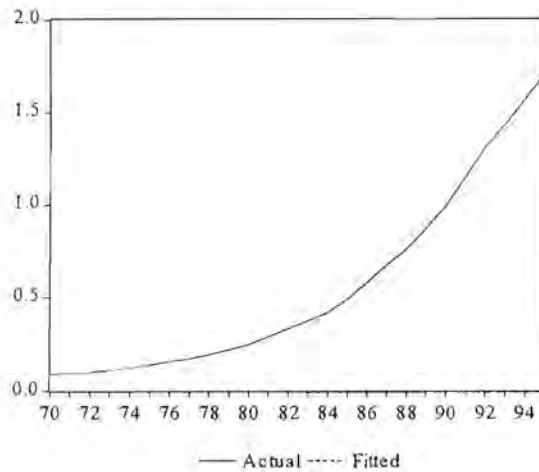
Figure 8.7   Actual and fitted values on ln_vpi

—— Actual ----- Fitted

Table 8.12   Simulation error statistics of consumer price index

Actual v Fitted : ln_cpi	
Root Mean Squared Error	0.003934
Mean Absolute Error	0.003303
Mean Absolute Percentage Error	0.551477
Theil Inequality Coefficient	0.001666
Bias Proportion	0.000000
Variance Proportion	0.006762
Covariance Proportion	0.993238

8.4   DYNAMIC SIMULATION: RESPONSE PROPERTIES OF THE MODEL

The methodology explained in Appendix 10 is now applied to investigate the dynamic properties of the price models and, simultaneously, to test them for stability and robustness.

The results of every adjustment process towards a new long-run equilibrium are both tabled and graphically illustrated. In every instance, the adjustment process is completed within the sample range and the levels of convergence of the dependent variables, are consistent with the elasticities of the respective cointegration relationships.

8.4.1   Production prices

Table 8.13   Difference between the baseline forecast and forecasts with shocked variables, dependent variable: ln_ppi

Variable	Coefficient	Expected change (10% of coefficient)	Convergence level (% difference)
ln_ucc2_nom	0.261397	0.026140	0.025194
ln_w_prod	0.603218	0.060322	0.059145

Figure 8.8   Dynamic adjustment (percentage change) in production price index (ln_ppi) with a 10 percent increase in nominal user-cost-of-capital (ln_ucc2_nom)
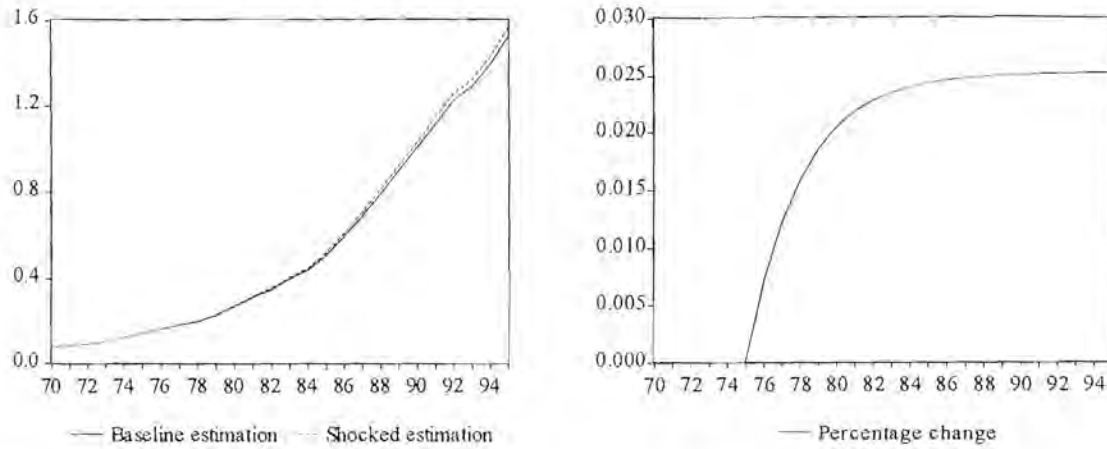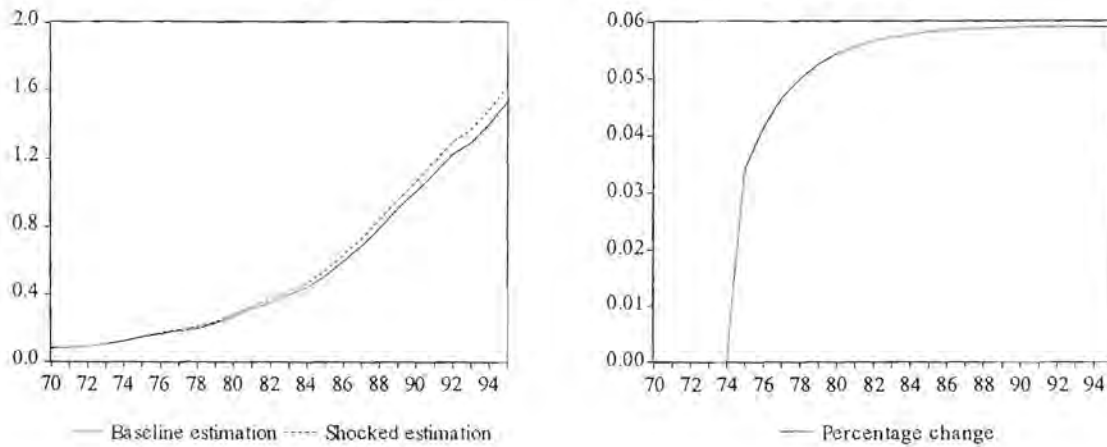

Figure 8.9   Dynamic adjustment (percentage change) in production price index (ln_ppi) with a 10 percent increase in wage productivity (ln_w_prod)

8.4.2   Consumption prices

Table 8.14   Difference between the baseline forecast and forecasts with shocked variables, dependent variable: ln_vpi

Variable	Coefficient	Expected change (10% of coefficient)	Convergence level (% difference)
ln_ppi	0.700000	0.070000	0.068967
ln_pz$	0.300000	0.030000	0.028004
ln_exces_dem_cp	1.431159	0.143116	0.143758
ln_r$	0.333681	0.033368	0.031213

Figure 8.10   Dynamic adjustment (percentage change) in consumer price index (ln_vpi)
with a 10 percent increase in production price index (ln_ppi)

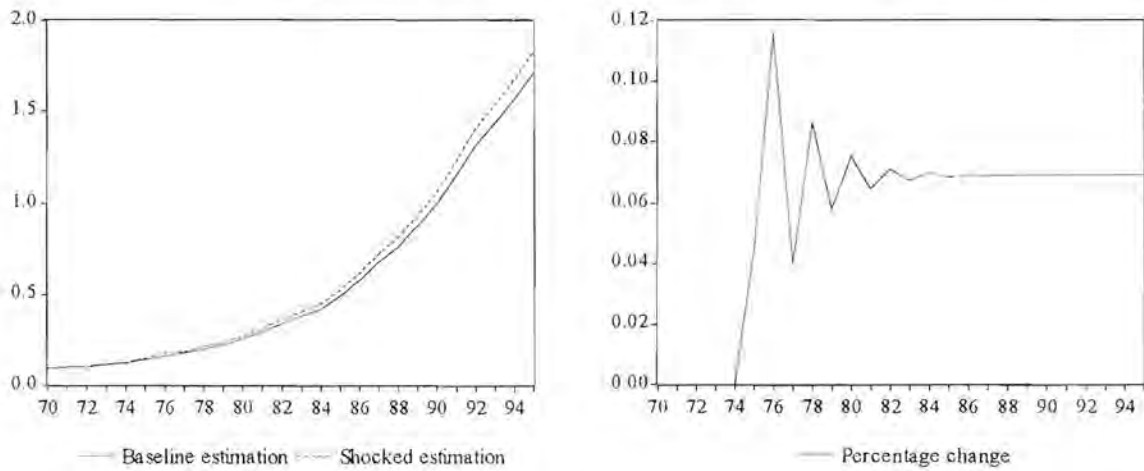Baseline estimation ---- Shocked estimation   Percentage change

Figure 8.11   Dynamic adjustment (percentage change) in consumer price index (ln_vpi)
with a 10 percent increase in import prices in US dollar (ln_pz$)

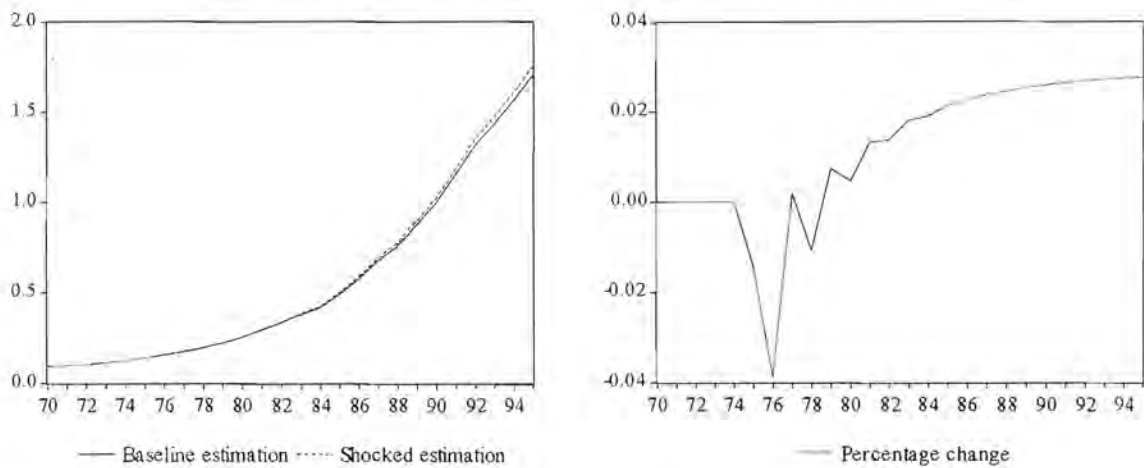Baseline estimation ---- Shocked estimation   Percentage change

Figure 8.12   Dynamic adjustment (percentage change) in consumer price index (ln_vpi)
with a 10 percent increase in nominal excess demand (ln_excess_dem_cp)

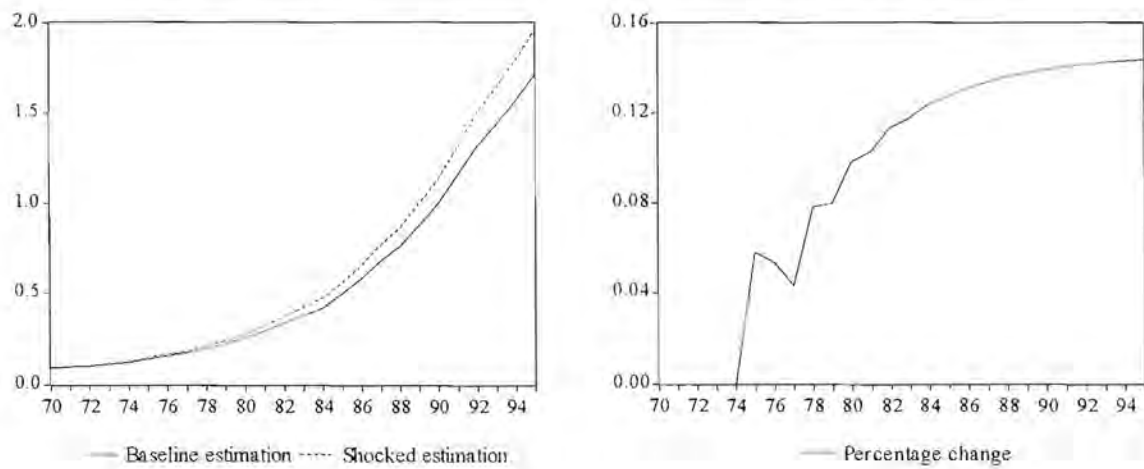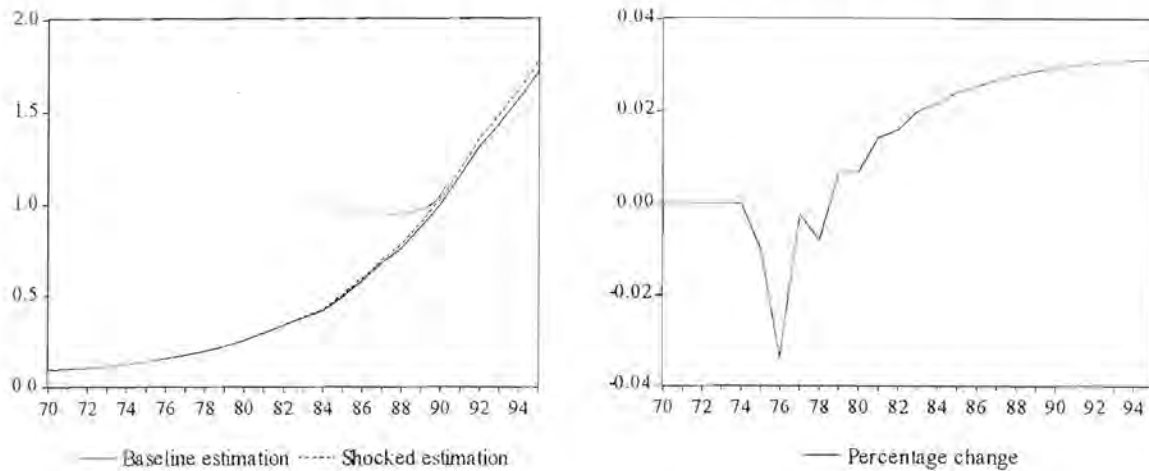Baseline estimation ---- Shocked estimation   Percentage change

Figure 8.13   Dynamic adjustment (percentage change) in consumer price index (ln_vpi) with a 10 percent increase in rand/dollar exchange rate (ln_r$)

Baseline estimation ····· Shocked estimation

Percentage change

8.5   CONCLUSION

In this chapter, models for both production (value-added) and consumption prices were proposed, estimated and validated. Consistency is maintained by deriving prices in similar fashion as wages (chapter 7) from an estimated cost function for the South African economy.

Assuming imperfect competition in a neoclassical, profit maximising framework, firms set their prices as a mark-up on the unit cost of production. Extending on the Layard-Nickell framework, the pricing models estimated in this study do not assume "normal" unit costs, but incorporate the unit costs of capital in addition to labour costs. The estimation results were consistent with the theoretical specification and *a priori* information on the price-setting behaviour of firms.

Regarding to inflation in South Africa, the estimated models suggest that (1) wage increases, relative to productivity growth exert the most pressure on production prices (60 percent), and (2) the consequences of the high degree of openness of the South African economy, represented by a set of international factors, are large contributors to domestic inflation.

CHAPTER 9

A SOUTH AFRICAN SUPPLY-SIDE MODEL: CLOSING THE SYSTEM AND MODEL EVALUATION

9.1 INTRODUCTION

In this chapter the estimations for production, fixed investment, corporate savings, the labour model and the pricing system are combined into a neoclassical supply-side model of the South African economy. The system is closed by introducing a number of identities and definitions, linking every endogenous variable in the model to ensure a fully dynamic system.

The model is subsequently evaluated along the criteria (full ideal principles of model selection) set out in Appendix 3.

First, the theoretical structure of the estimated model (empirical specification) is evaluated to determine the compliancy of the model with (1) the *a priori* objectives of neoclassical supply-side modelling, (2) economic theory – for the model in general and the individual equations in particular, (3) rival models, i.e. the extent to which the model encompasses the characteristics of rival models, and (4) policy analysis, i.e. the relevancy of the specified model for policy analysis.

Second, a simulation (i.e. *ex post* forecast) of the full system of equations is conducted. The dynamic simulation properties of the model are evaluated in terms of (1) the statistical significance (*ex-post* forecast ability) and (2) the stability of the model over the simulated sample range. The statistical significance (goodness-of-fit) of the full system is measured in terms of simulation/forecast error statistics and confirmed by the graphical representations of the simulations.

Third, a series of dynamic, ex-post simulations are conducted by shocking every stochastic variable in the system. The simulation results are used to (1) determine the long-run (steady-state) multipliers and elasticities of the system and, once again, (2) to evaluate the statistical significance and sensitivity of the model in terms of the degree, speed and stability of convergence. The robust (stable) nature of the model serves as an indication of the forecasting ability of the model.

9.2 CLOSING THE SYSTEM: A NEOCLASSICAL SUPPLY-SIDE MODEL OF THE SOUTH AFRICAN ECONOMY

Having specified and estimated individual functions in a consistent cost-minimising framework for:
(i)   real gross domestic production;
(ii)   real fixed domestic investment;
(iii)   nominal corporate savings;
(iv)   demand for skilled labour;
(v)   demand for unskilled labour;
(vi)   labour participants in the informal sector;
(vii)   total labour supply;

(viii)   skilled labour supply;
(ix)   nominal skilled wage rate;
(x)   real unskilled wage rate;
(xi)   production (value-added) prices; and
(xii)   consumption prices,

the production, investment, labour and price systems are combined and linked by a number of identities and definitions into a neoclassical supply-side model of the South African economy.

The empirical specification (equations and estimated parameters) of the estimated supply-side system follows:[1]

SUPPLY-SIDE MODEL

IDENTITIES & DEFINITIONS

Capacity utilisation

cu = ((bbpfact_90p/bbppot_90p)*100)
ln_cu = log(cu)

Production

bbpfact_90p = EXP(ln_bbpfact_90p)
bbpfact_cp = bbpfact_90p*ppi

bbp_90p = bbpfact_90p + (txind - subs)/pnettx
ln_bbp_90p = log(bbp_90p)
bbp_cp = bbp_90p*vpi

bbppot_90p = EXP(ln_bbppot_90p)

Capital stock

kap_r = ((1 - 0.05)*kap_r(-1)) + if
ln_kap_r = log(kap_r)

kap_lab_rat = (kap_r/n)
ln_kap_lab_rat = log(kap_lab_rat)

Investment : domestic

if = EXP(ln_if)
if_cp = if*ppi

totdomi_cp = if_cp + inv_cp

Financing of investment

fincond_cp = sp_cp + sg_cp + sc_cp + de_cp + netcapfl + gold_reserv_cp

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[1]   A list of variables is presented in Appendix 8.

fincond_ppi = fincond_cp/ppi
ln_fincond_ppi = log(fincond_ppi)

Corporate savings

sc_cp = EXP(ln_sc_cp)
sc_cp_rat = sc_cp/bbp_cp

lab_rem_cp = w_tot*n
gos_cp = bbpfact_cp - lab_rem_cp
gostc_cp = gos_cp - tc_cp
ln_gostc_cp = log(gostc_cp)

Labour productivity

product = (bbp_90p/n_sarb)/49004.99*100
ln_product = log(product)

Wages : unskilled labour

wu_vpi_rate = EXP(ln_wuvpi_rat)
wu_vpi = wu_vpi_rate*n_u

w_u = wu_vpi*vpi
wu_rate = wu_vpi_rate*vpi

wu_ppi = w_u/ppi
wu_ppi_rate = wu_ppi/n_u
ln_wuppi_rat = log(wu_ppi_rate)

Wages : skilled labour

ws_rate = EXP(ln_ws_rate)

ws_vpi_rate = ws_rate/vpi
ws_vpi = ws_vpi_rate*n_s
ln_wsvpi_rat = log(ws_vpi_rate)

w_s = ws_vpi*vpi

Wages : total labour force

w_tot = w_s + w_u
wtot_rate = w_tot/n
ln_wtot_rate = log(wtot_rate)

wtot_vpi = (w_s + w_u)/vpi
ln_wtot_vpi = log((w_s + w_u)/vpi)
wtot_vpi_rat = ((w_s + w_u)/vpi)/n
ln_wtot_vpi_rat = log(wtot_vpi_rat)

wu_share = w_u/w_tot
ws_share = w_s/w_tot

Wage productivity

w_prod = w_tot/product
ln_w_prod = log(w_prod)

Relative wages

rel_wsu = w_s/w_u
rel_wsu_rat = (w_s/n_s)/(w_u/n_u)
ln_rel_wsu_rat = log(rel_wsu_rat)

Cost of labour

Pension contribution = 0.06 (6%)
Medical contribution = 0.1 (10%)
Non-wage contributions = medical + pension = 0.16 (16%)
Corporate income tax rate = 0.3 (30%)

w_cost_cp = ((wtot_rate)*(1 + 0.16))/(1 - (tc_rate_cp)*(1 + 0.3))

ws_cost_cp = ws_share*w_cost_cp
ws_cost_ppi = ws_cost_cp/ppi
ln_wscost_ppi = log(ws_cost_ppi)

wu_cost_cp = wu_share*w_cost_cp
wu_cost_ppi = wu_cost_cp/ppi
ln_wucost_ppi = log(wu_cost_ppi)

rel_wscost_ucc = ws_cost_ppi/ucc2_90p
ln_rel_wscost_u = log(rel_wscost_ucc)

rel_wucost_ucc = wu_cost_ppi/ucc2_90p
ln_rel_wucost_u = log(rel_wucost_ucc)

Demand for labour (employment)

n_informal = EXP(ln_n_informal)

n_s = EXP(ln_ns)

n_u = EXP(ln_nu)

n = n_s + n_u
ln_n = log(n)
n_sarb = n-n_diff

n_pot = (s_smooth*(1 - nawru_hpf))
ln_n_pot = log(n_pot)

Supply of labour

s = EXP(ln_s)

s_rat = s/total_pop*1000
s_smooth = ((total_pop)*(s_rat_hpf))/1000

s_s = EXP(ln_ss)
ss_rat = s_s/s

s_u = s - s_s

Employment rates

empl_rat = (n/s)
ln_empl_rat = log(empl_rat)

empl_rat_s = (n_s/s_s)
ln_emplrat_s = log(empl_rat_s)

empl_rat_u = (n_u/s_u)
ln_emplrat_u = log(empl_rat_u)

Unemployment rates

unempl_rat = (s-n)/s
ln_unempl_rat = log(unempl_rat)

unempl_rat_s = (s_s-n_s)/s_s
ln_unemplrat_s = log(unempl_rat_s)

unempl_rat_u = (s_u-n_u)/s_u
ln_unemplrat_u = log(unempl_rat_u)

unempl = s - n
unempl_s = s_s - n_s
unempl_u = s_u - n_u

Index: technology

tecno_index = (educ_index/1.51)*0.15 + (product/100)*0.15 + (rel_i_r/1.805383)*0.05 + (time + tecno_innov)*0.65

Index: education

ln_educind = log(educ_index)

Index: socio-economic conditions

soc_index = (educ_index/0.51)*0.20 + (energy_ind/100)*0.15 + (health_index/0.62)*0.15 + (1/(crime_index/1.65))*0.1 + (income_index/4353)*0.2 + (h_transf_receiv/727)*0.1 + (unpl_ben/556693)*0.1

ln_socind = log(soc_index)

Index: union pressure

depend_rat = (total_pop - s)/s

union_power = union_members/n
ln_unionpower = log(union_power)

union_mil = union_work_lost/n

union_pres_ind = ((union_power/243623.8)*0.60 + (union_mil/272984.5)*0.10 +
(depend_rat/1.965280)*0.30)

ln_uniopresind = log(union_pres_ind)

Index: international position

indinves_r = indinvest/ppi
rel_indi_r = (indinvest/totdomi_cp)/ppi

dirinves_r = dirinvest/ppi
rel_diri_r = (dirinvest/totdomi_cp)/ppi

rel_i_r = ((indinvest + dirinvest)/totdomi_cp)/ppi

exchange_rate = 100/r_$

netcapfl_r = netcapfl/ppi

intern_posind = ((exchange_rate/0.386444)*0.2 + (intern_comp)*0.05 + (rel_diri_r/0.44804)*0.5 +
(rel_indi_r/1.357343)*0.2 + (worldshare/0.706)*0.05)

ln_interposind = log(intern_posind)

Government

pnettx = (txind - subs)/(bbp_90p - bbpfact_90p)

Exports

xgoud_ppi = xgoud_cp/ppi
ln_xgoud_ppi = log(xgoud_ppi)

xgoud_px = xgoud_cp/px
ln_xgoud_px = log(xgoud_px)

gprys_r = (gprys_$*r_$)/100
ln_gprys_r = log(gprys_r)

User-cost-of-capital

dipi = if_cp/if

pk_ppi = pk - ppigrowth

tc_rate_cp = tc_cp/bbpfact_cp
tc_rate_ppi = tc_rate_cp/ppi

ucc2_90p = dipi*((pk_ppi/100) + 0.2)/(1 - tc_rate_ppi)
ln_ucc2_90p = log(ucc2_90p)

ucc2_nom = dipi*((pk/100) + 0.2)/(1 - tc_rate_cp)
ln_ucc2_nom = log(ucc2_nom)

Prices

vpi = EXP(ln_vpi) + error_vpi
vpigrowth = (vpi - vpi(-1))/vpi(-1)*100

ppi = EXP(ln_ppi) + error_ppi
ppigrowth = (ppi - ppi(-1))/ppi(-1)*100

Import prices

pz_$ = pz*exchange_rate
ln_pz$ = log(pz_$)

Excess demand

excess_dem_cp = bbb_cp/bbp_cp
ln_exces_dem_cp = log(excess_dem_cp)

STOCHASTIC FUNCTIONS

Production function derived from cost function

Actual production

etmin1_bbp = ln_bbpfact_90p(-1) - 0.0788626*ln_kap_r(-1) - 0.7727844*ln_n(-1) -
0.0448234*tecno_index(-1) - 9.488127

ln_bbpfact_90p = -0.445426*etmin1_bbp + 1.565503*(ln_kap_r - ln_kap_r(-1)) -
1.467576*(ln_kap_r(-1) - ln_kap_r(-2)) + 0.606197*(ln_n - ln_n(-1)) +
0.147462*(tecno_index- tecno_index(-1)) + 0.077070*(tecno_index(-4) -
tecno_index(-5)) - 0.036744*(drought_dum) - 0.029635*(sanction_dum) -
0.025683*(imf_dum) + 0.025426 + ln_bbpfact_90p(-1)

Potential production

etmin1_bbpp = ln_bbppot_90p(-1) - 0.0788626*ln_kap_r(-1) - 0.7727844*ln_n_pot(-1) -
0.0448234*tecno_hpf(-1) - 9.488127

ln_bbppot_90p = -0.445426*etmin1_bbpp + 1.565503*(ln_kap_r - ln_kap_r(-1)) -
1.467576*(ln_kap_r(-1) - ln_kap_r(-2)) + 0.606197*(ln_n_pot- ln_n_pot(-1)) +
0.147462*(tecno_hpf- tecno_hpf(-1)) + 0.077070*(tecno_hpf(-4) –
tecno_hpf(-5)) - 0.036744*(drought_dum) - 0.029635*(sanction_dum) -
0.025683*(imf_dum) + 0.025426 + ln_bbppot_90p(-1)

Investment function

etmin1_if = ln_if(-1) - 0.335012*ln_bbpfact_90p(-1) + 0.128864*(ln_ucc2_90p(-1)) -
0.555366*ln_fincond_ppi(-1) - 6.31E-07*kap_r(-1)

ln_if = 3.97E-06*(kap_r(-1) - kap_r(-2)) - 0.941551*(ln_vpi - ln_vpi(-1)) +
0.976882*(ln_vpi(-2) - ln_vpi(-3)) - 1.037919*(ln_p_manuf(-1) - ln_p_manuf(-2))
+0.412439*(ln_p_manuf(-3) - ln_p_manuf(-4)) + 0.355705*(ln_fincond_ppi -
ln_fincond_ppi(-1)) + 0.158596*(ln_fincond_ppi(-1) - ln_fincond_ppi(-2)) +
0.162331*(ln_fincond_ppi(-2) - ln_fincond_ppi(-3)) - 0.941250*etmin1_if + ln_if(-1)

Savings function

etmin1_sc = ln_sc_cp(-1) - (0.810837)*ln_gostc_cp(-1)

ln_sc_cp = - 0.122745*etmin1_sc + 1.312995*(ln_gostc_cp - ln_gostc_cp(-1)) -
0.400409*(imf_dum - imf_dum(-1)) + 0.323139*(opec_dum2) -
0.243745*(sanction_dum - sanction_dum(-1)) + ln_sc_cp(-1)

Labour demand - informal

etmin1_n_inf = ln_n_informal(-1) + 25.03542 - 6.530056*ln_bbp_90p(-1) +
4.399687*ln_wtot_vpi_rat(-1)

ln_n_informal = 0.291756*(ln_n_informal(-1) - ln_n_informal(-2)) - 0.439398*(ln_n_informal(-2)
- ln_n_informal(-3)) + 0.318244*(ln_interposind - ln_interposind(-1)) +
0.496072*(ln_r$(-1) - ln_r$(-2)) + 0.771041*(ln_r$(-2) - ln_r$(-3))
+0.181036*(ln_xgoud_ppi - ln_xgoud_ppi(-1)) - 0.521724*(ln_xgoud_ppi(-2) -
ln_xgoud_ppi(-3)) + 0.293102*(ln_gprys_$(-1) - ln_gprys_$(-2)) +
0.360206*(ln_gprys_$(-2) - ln_gprys_$(-3)) - 0.689871*(ln_socind(-2) -
ln_socind(-3)) + 1.128687*(ln_bbp_min_90p(-1) - ln_bbp_min_90p(-2)) +
0.410871*(ln_unempl_rat - ln_unempl_rat(-1)) - 0.516895*etmin1_n_inf +
ln_n_informal(-1)

Labour demand - skilled

etmin1_ns = ln_ns(-1) -0.309833*ln_bbp_90p(-1) + 0.61238*ln_rel_wsu_rat(-1) +
0.137105*ln_rel_wscost_u(-1)

ln_ns = 0.018879- 0.294219*etmin1_ns + 0.329872*(ln_bbp_90p - ln_bbp_90p(-1)) +
0.496150*(ln_bbp_90p(-1) - ln_bbp_90p(-2)) + 0.415129*(ln_bbp_90p(-2) -
ln_bbp_90p(-3)) - 0.162451*(ln_rel_wsu_rat - ln_rel_wsu_rat(-1)) +
0.132016*(ln_rel_wsu_rat(-3) - ln_rel_wsu_rat(-4)) + 0.078446*(ln_interposind(-2) -
ln_interposind(-3)) - 0.023055*(sanction_dum - sanction_dum(-1)) +
0.250117*(ln_kap_lab_rat(-1) - ln_kap_lab_rat(-2)) - 0.037895*(ln_rel_wscost_u -
ln_rel_wscost_u(-1)) - 0.022202*(ln_uniopresind(-2) - ln_uniopresind(-3)) + ln_ns(-1)

Labour demand - unskilled

etmin1_nu = ln_nu(-1) - 0.375655*ln_bbp_90p(-1) + 0.353469*ln_wuppi_rat(-1)

ln_nu = -0.130607*etmin1_nu - 0.083803*(ln_socind - ln_socind(-1))
+ 0.059588*(ln_socind(-1) - ln_socind(-2)) - 0.074636*(ln_interposind -
ln_interposind(-1)) - 0.019511*(ln_interposind(-3) - ln_interposind(-4)) +
0.068958*(ln_gprys_r(-2) - ln_gprys_r(-3)) + 0.022791*(sanction_dum -
sanction_dum(-1)) - 0.030357*(ln_uniopresind(-1) - ln_uniopresind(-2)) +
0.046513*(ln_uniopresind(-3) - ln_uniopresind(-4)) - 0.101683*(ln_bbp_90p(-1) -
ln_bbp_90p(-2)) - 0.022128 + ln_nu(-1)

Supply of labour : total

etmin1_s = ln_s(-1) - 0.4812201*ln_total_pop(-1) - 0.1355454*ln_wtot_rate(-1) + 3.834824

ln_s = - 0.897759*etmin1_s - 0.552752*(ln_s(-1) - ln_s(-2)) - 0.347900*(ln_s(-2) - ln_s(-3)) -
0.201420*(ln_empl_rat(-1) - ln_empl_rat(-2)) + 0.101256*(ln_empl_rat(-2)
- ln_empl_rat(-3)) + 0.010675*(ln_cu(-1)) - 0.021152*(ln_interposind - ln_interposind(-1))
- 0.020555*(ln_interposind(-1) - ln_interposind(-2)) - 0.010088*(ln_interposind(-2) -
ln_interposind(-3)) + ln_s(-1)

Supply of labour : skilled

etmin1_ss = ln_ss(-1) - 0.47599*ln_educind(-1) - 1.677626*ln_wtot_vpi_rat(-1) + 14.59531

ln_ss = - 0.040049*etmin1_ss + 1.268536*(ln_s - ln_s(-1)) + 0.739383*(ln_ss(-1) - ln_ss(-2)) -
0.008025*braindrain_dum -0.024742 + ln_ss(-1)

Wage rate : unskilled

etmin1_wu = ln_wuvpi_rat(-1) - 0.055575*ln_vpi(1-1) - 0.393319*ln_xgoud_px(-1) -
1.055957*ln_product2(-1)

ln_wuvpi_rat = - 0.186843*etmin1_wu + 0.186627*(ln_socind - ln_socind(-1)) -
0.130427*(ln_socind(-2) - ln_socind(-3)) + 0.178179*(ln_socind(-3) -
ln_socind(-4)) - 0.107496*(ln_xgoud_px - ln_xgoud_px(-1)) +
0.170801*(ln_xgoud_px(-1) - ln_xgoud_px(-2)) - 0.101029*(ln_xgoud_px(-2) -
ln_xgoud_px(-3)) - 0.163723*(ln_xgoud_px(-3) - ln_xgoud_px(-4)) +
0.216062*(ln_uniopresind(-1) - ln_uniopresind(-2)) + 0.140599*(ln_gprys_$(-3)
- ln_gprys_$(-4)) - 0.033496*sanction_dum + ln_wuvpi_rat(-1)

Wage rate : skilled

etmin1_ws = ln_ws_rate(-1) - 0.876221*ln_vpi - 0.675239*ln_product(-1) - 6.807242

ln_ws_rate = - 0.546388*etmin1_ws + 0.857995*(ln_emplrat_s(-1) - ln_emplrat_s(-2)) +
0.075203*(ln_interposind - ln_interposind(-1)) + 0.029546*braindrain_dum +
0.107963 + ln_ws_rate(-1)

Production price index

etmin1_ppi = ln_ppi(-1) - 0.261397*ln_ucc2_nom(-1) - 0.603218*ln_w_prod(-1) + 4.146606

ln_ppi = -0.283469*etmin1_ppi + 0.012082*(ln_cu(-2)) - 0.127054*(ln_interposind - ln_interposind(-1)) + 0.032431*(sanction_dum - sanction_dum(-1)) + 0.351462*(ln_w_prod - ln_w_prod(-1)) + ln_ppi(-1)

Consumer price index

etmin1_vpi = ln_vpi(-1) - 0.7*ln_ppi(-1) - 0.3*ln_pz$(-1) - 1.431159*ln_exces_dem_cp(-1) - 0.333681*ln_r$(-1) + 1.478081

ln_vpi = - 0.298653*etmin1_vpi + 0.454890*(ln_ppi - ln_ppi(-1)) + 0.847749*(ln_ppi(-1) - ln_ppi(-2)) - 0.258956*(ln_ppi(-2) - ln_ppi(-3)) + 0.592261*(ln_exces_dem_cp - ln_exces_dem_cp(-1)) - 0.392387*(ln_exces_dem_cp(-2) - ln_exces_dem_cp(-3)) - 0.166641*(ln_prime_rate - ln_prime_rate(-1)) + 0.070108*(ln_prime_rate(-1) - ln_prime_rate(-2)) - 0.498413*(ln_vpi(-1) - ln_vpi(-2)) - 0.150988*(ln_pz$ - ln_pz$(-1)) - 0.472941*(ln_pz$(-1) - ln_pz$(-2)) + 0.089553*(ln_pz$(-2) - ln_pz$(-3)) - 0.104279*(ln_r$ - ln_r$(-1)) - 0.440339*(ln_r$(-1) - ln_r$(-2)) + 0.122906 + ln_vpi(-1)

9.3   MODEL EVALUATION

The estimated model is evaluated according to a number of criteria. The full system, as well as the individual equations, have to (1) be consistent with economic theory, (2) be economically and statistically significant, (3) provide an adequate representation of the data, (4) encompass the characteristics of rival models and (5) not be overly sensitive to sample range, variable menu or other equations of the system.

Macroeconomic models must in addition to the above-mentioned points of criteria be evaluated in terms of the objective(s) of their construction, albeit structural analysis, relevance to policy analysis and/or forecasting.

9.3.1   Structural (theoretical) properties

The first aim is to identify the structural and theoretical properties of the final supply-side system and to determine extent to which they comply with (1) the primary objectives; (2) economic theory; (3) rival models and (4) a framework for policy analysis and forecasting.

The discussion is structured by identifying (1) the primary objectives, (2) the associated conceptual issues, (3) the subsequent structural properties of the model and (4) comparative aspects in rival models.

The *primary objectives* stated in the beginning of the research were:

(i)   To develop an aggregate neoclassical supply-side model of the South African economy, pertaining to the structural and long-run properties of the economy, as well as the profit-maximising and cost-minimising decision-making processes of firms;

(ii)   To specify, derive and estimate every structural relationship (equation) of the model jointly to ensure consistency between costs, demand factors and prices throughout the analytical framework;

(iii)   To incorporate an estimate for capacity utilisation which serves as a significant variable in explaining price- and wage-setting behaviour and which also influences every key macroeconomic variable in a well-developed supply-system;

(iv)   To endogenise technical progress in the cost/production relationship;

(v)   To incorporate price expectations;

(vi)   To allow for the specific and rather unique characteristics of the South African economy;

(vii)   To incorporate a set of target or policy variables allowing for policy proposals with specific reference to the unemployment problem in South Africa; and

(viii) To maintain a balance between the detail required for policy analysis and the stability of the model to ensure reliable forecasts.

A number of *conceptual issues* had to be decided on and dealt with in striving to achieve the above-mentioned objectives:

(i)   A cost or a production function approach in estimating the structural production properties of the South African economy;

(ii)   An appropriate functional form and underlying production technology for the cost/production function;

(iii)   An appropriate measure or estimate for technical progress;

(iv)   Assumptions about the factor intensity of production and the returns to scale property of the South African production structure;

(v)   An appropriate measure for capacity utilisation (expenditure/demand *versus* production/supply as measure for actual output);

(vi)   An appropriate measure for potential output;

(vii)   An appropriate measure for the NAIRU/NAWRU;

(viii) An appropriate model for investment (neoclassical/Jorgenson *versus* cash-flow *versus* Tobin's q);

(ix)   A measure for user-cost-of-capital;

(x)   A market-clearing *versus* a non-market clearing approach in modelling labour;

(xi)   A distinction between skilled and unskilled labour;

(xii)   An appropriate wage-setting model (framework of market imperfections: union-firm wage-bargaining);

(xiii) An appropriate price-setting model (framework of market imperfections: mark-up on unit cost of production); and

(xiv) Exclusion (standard approach) *versus* inclusion of unit cost of capital.

Bearing the primary objectives in mind and dealing with the previously mentioned conceptual issues, resulted in an estimated supply-side model with the following *structural properties*:

(i)   Neoclassical supply-side system;

(ii)   Based on cost-minimising behaviour of firms, a cost function was estimated and used to derive a production function on the principles of Shephard's duality;

(iii)   The Cobb-Douglas functional form, restricting the elasticity of substitution to unity, was validated as an appropriate representation of the production structure in South Africa;

(iv)   South Africa has been proven to produce labour intensively and with decreasing returns to scale;

(v)   Technical progress has been endogenised by incorporating imported technical innovation, human capital augmentation and labour augmentation (Harrod neutral);

(vi)   Capacity utilisation is measured in terms of actual value-added output (estimated by the production function) relative to potential output, where potential output is structurally determined by means of the production function;

(vii)   Potential labour is not smoothed as in the case of "normal" output, but estimated by incorporating the NAWRU;

(viii)   The NAWRU (non-accelerating wage rate of unemployment) is measured in terms of the gap between unemployment and wages;

(ix)   Real fixed investment has been proven to be significantly dependent on financial constraints – the cash flow model has been combined with the Jorgenson neoclassical model in explaining investment in South Africa;

(x)   The Jorgenson measure for user-cost-of-capital has been derived and utilised for the South African context. This measure combines four effects, i.e. the price of capital, rates of return, depreciation and taxes;

(xi)   Every factor demand and price equation was derived and estimated consistent with the estimated cost function;

(xii)   A distinction is made between skilled and unskilled labour markets, emphasising the role of education and explaining the structural nature of the unemployment problem in South Africa;

(xiii)   The reasons for a growing number of labour participants in the informal sector are modelled (e.g. lack of labour absorption capacity in the formal sector);

(xiv)   Wage-setting is explained in terms of a union-firm bargaining model, i.e. under imperfect competition, incorporating the effects of labour productivity, expected inflation and a set of wage pressure variables;

(xv)   Prices are also explained in a framework of market imperfections, where firms set their prices as a mark-up on unit cost of production;

(xvi)   The standard assumption of "normal" unit costs is extended by incorporating the unit cost of capital;

(xvii)   Value added or production prices are primarily dependent on the unit cost of capital, the unit cost of labour adjusted for labour productivity and capacity utilisation;

(xviii)   Consumption prices are dependent on production prices, import prices, the exchange rate, and demand pressures (excess demand) on the long-run;

(xix)   Unique characteristics of the South African economy were modelled: (1) the international vulnerability of the South African economy due to the large degree of openness and the relatively small size of the economy; (2) the period of economic sanctions and disinvestment resulted from the country's political dispensation - causing a structural break in each of the relevant data series; (3) South Africa's dependence on foreign investment and financing; (4) the powerful and militant role of labour unions; and (5) socio-economic problems – the heritage of "apartheid"; and

(xx) Some target variables are included in the model to allow for policy proposals: taxes, subsidies, prime overdraft rate of banks, tax depreciation rates, education, health index, crime index, government transfers to households, unemployment benefits and electricity provision.

Every structural (stochastic) equation included in the neoclassical system has been theoretically validated (see chapters 4 to 8).

Table 9.1 presents the encompassing results of the South African supply-side model. The structural properties are compared with those of rival models. The LBS and OECD models, which may be considered as leaders in the field of macroeconometric modelling, are utilised for this purpose. The work of Layard and Nickell (1985, 1986; Nickell, 1988) has most recently set the tone for supply-side modelling and has been incorporated by both the LBS and OECD models in varying degrees.

9.3.2 Dynamic simulation properties

A dynamic simulation (*ex-post* forecast) of the complete supply-side model is conducted to evaluate the statistical significance and stability of the model. The graphical illustrations (figure 9.1) of the simulation results (actual *versus* fitted values) serve as an indication of the ability of the model to adequately represent the historical data (statistical significance) and the stability of the model. The statistical significance (goodness-of-fit) of the full system is also measured in terms of a set of simulation/forecast error statistics[2] (table 9.2).

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[2] See Appendix 2 for an exposition of the simulation error statistics.

Table 9.1   Encompassing results

Structural properties		LBS	OECD	SA
Production sector	*Cost/production approach*	Cost function	Production function	Cost to production function
	Functional form	Translog	Cobb-Douglas and CES	Cobb-Douglas
	Technical progress	Labour augmenting (Harrod neutral)	Labour augmenting (Harrod neutral)	Labour augmenting (Harrod neutral), human capital augmenting, imported technical innovation and exogenous innovation
Capacity utilisation (cu)	*Actual output*	n.a.	Actual output estimated by production function	Actual output estimated by production function
	Potential output	n.a.	Normal (trending) output, a structural production function approach	Potential output, a structural production function approach
Investment	*Model*	Tobin's q	Neoclassical (Jorgenson)	Neoclassical (Jorgenson) combined with cash flow model (financial constraints)
	User-cost-of-capital (r)	Rental cost	User-cost-of-capital (r) = f(price of capital, depreciation, rates of return)	User-cost-of-capital (r) = f(price of capital, depreciation, rates of return, taxes)
Labour: demand	*Market- or non-market clearing*	Non-market clearing approach, assuming NAIRU	Non-market clearing approach, assuming NAWRU	Non-market clearing approach, assuming NAWRU
Labour: supply	*Exogenous/LFP*	Labour force participation function	Labour force participation function	Labour force participation function
Wage-setting	*Model*	Wage-bargaining & wage productivity	Wage-bargaining & wage productivity	Wage-bargaining & wage productivity
Price-setting	*Model*	Mark-up on unit costs	Mark-up on unit costs, cu, r	Mark-up on unit costs, cu, r
Expectations		Learning in exchange rate function	none	Expected inflation in wage equation

Table 9.2   Dynamic simulation accuracy (goodness-of-fit) of the individual stochastic variables in the supply-side model

Stochastic variables		Simulation error statistics[3]				
		Root mean square simulation error (RMSE)	Mean absolute simulation error (MAE)	Root mean square percentage error (RMSPE)	Mean absolute percentage error (MAPE)	Theil inequality coefficient (U)
Real GDP at factor cost	ln_bbpfact_90p	0.005277	-0.001180	0.000429	-0.000096	0.000071
Real fixed investment	ln_if	0.051037	-0.011412	0.004608	-0.001030	0.000403
Nominal corporate savings	ln_sc_cp	0.012768	0.002855	0.002754	-0.000616	0.000132
Skilled labour demand	ln_ns	0.092575	0.020700	0.072106	0.016123	0.006126
Unskilled labour demand	ln_nu	0.030334	0.006783	0.019231	0.004300	0.001656
Labour participants in the informal sector	ln_n_informal	0.061234	-0.013692	0.004723	-0.001056	0.000383
Labour supply	ln_s	0.000988	-0.000221	0.000558	-0.000125	0.000037
Skilled labour supply	ln_ss	0.090179	-0.020165	0.065682	-0.014687	0.005501
Nominal skilled wage rate	ln_ws_rate	0.061612	-0.013777	0.007000	-0.001565	0.000581
Real unskilled wage rate	ln_wuvpi_rat	0.037693	-0.008428	0.004327	-0.000968	0.000374
Production price index	ln_ppi	0.061172	0.013678	0.011815	-0.002642	0.004760
Consumer price index	ln_vpi	0.085137	0.019037	0.092775	-0.020745	0.006483

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[3]   See Appendix 2 for an exposition of the relevant formulae.

Figure 9.1   Dynamic simulation properties of the supply-side model

Real GDP at factor cost

Capacity utilisation

Real domestic investment

Labour participants in the informal sector

Demand for skilled labour

Demand for unskilled labour

Figure 9.1 (*cont.*)

Production price index

Labour supply

Nominal corporate savings

Skilled labour supply

Consumer price index

Nominal skilled wage rate

Figure 9.1 *(cont.)*

Real unskilled wage rate

— Actual — Fitted
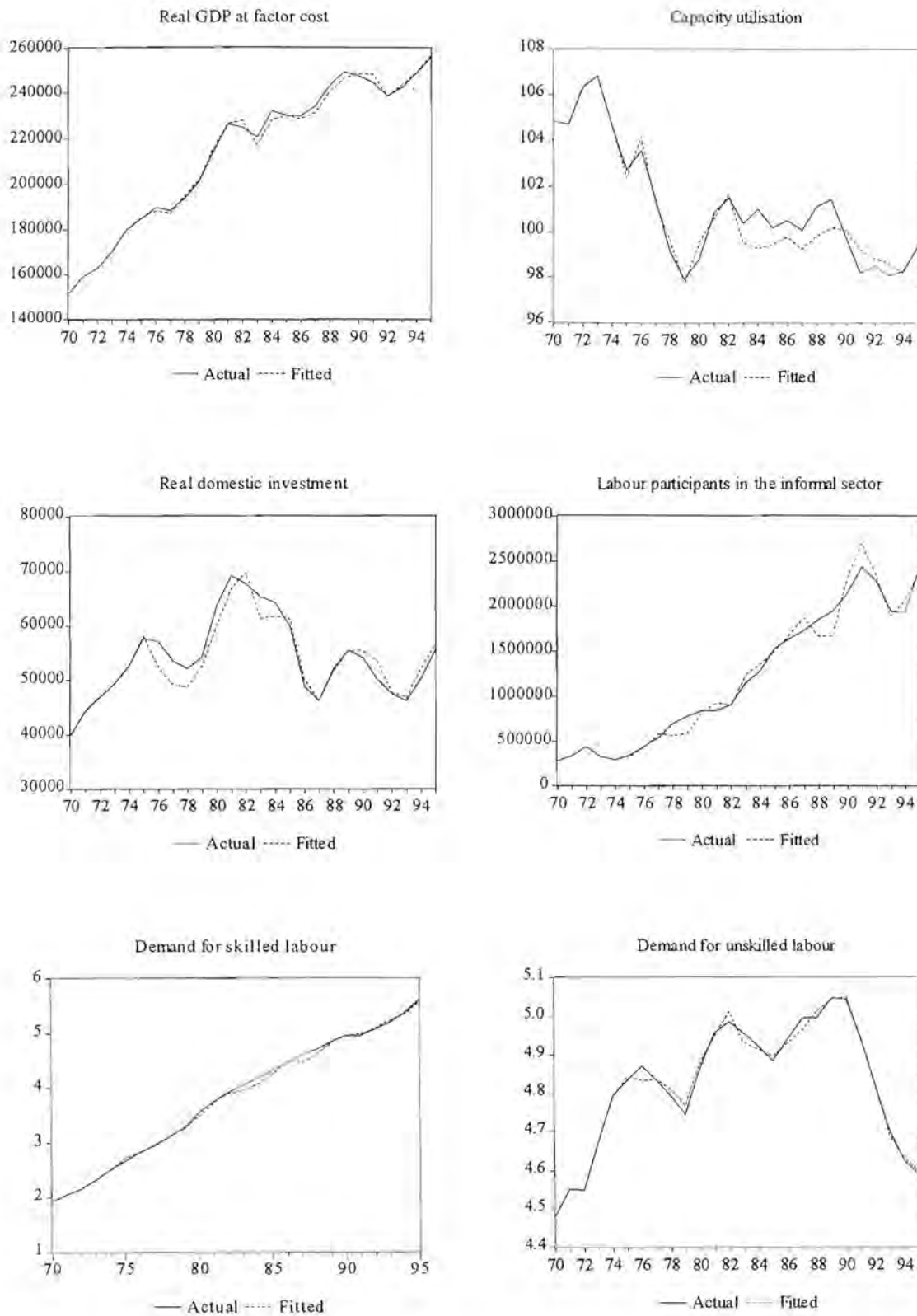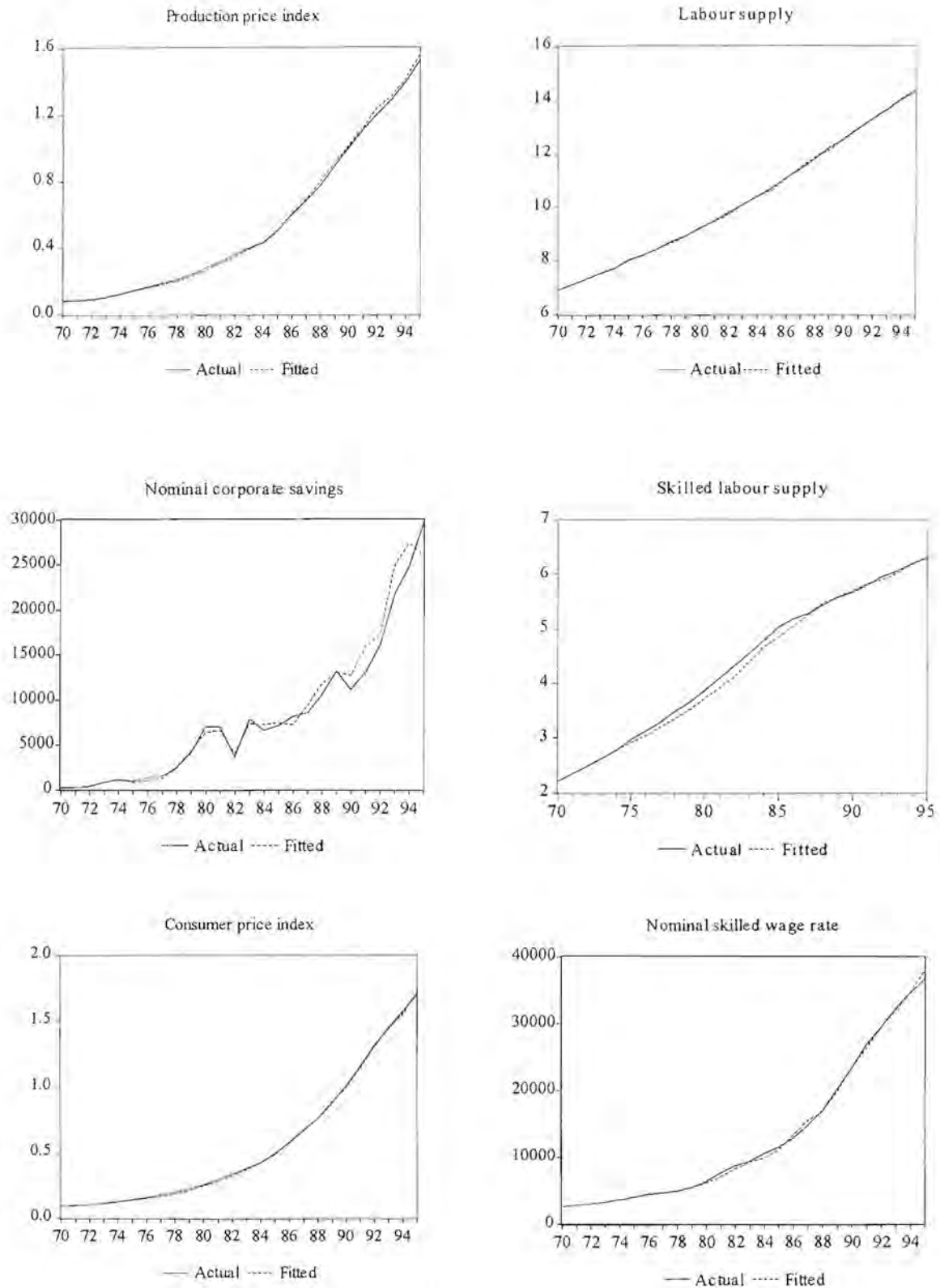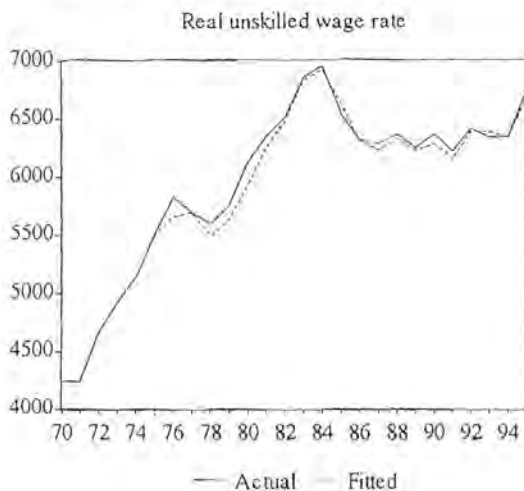
9.3.3 Long-run response properties

The purpose of this section is to determine the long-run multipliers and elasticities of the neoclassical supply-side model. Since the system of equations is non-linear, it is not possible to derive or compute these properties directly from the reduced form. For this reason a series of dynamic, *ex post* simulations are conducted by shocking a stochastic (hereafter "shocked" or "source") variable in the system to determine the multiplier (relative change) and elasticity (relative percentage change) for every response variable in reaction to the shocked (source) variable.

The multipliers/elasticities are obtained by comparing every response variable's baseline simulation path with its shocked simulation path. A multiplier is defined as the change in the response variable relative to the absolute value of the shock applied, while an elasticity is defined as the percentage change in the response variable relative to the percentage shock applied. The multiplier (elasticity) at convergence is the long-run, steady-state or comparative static multiplier (elasticity)[4], while the multipliers (elasticities) determined along the simulation path are referred to as the dynamic multipliers (elasticities).

The multipliers of a particular source variable are determined by applying a constant exogenous shock to the source variable from 1975 onwards, i.e. by increasing the source data series with a constant value equal to 10 percent of its 1975-observed value.[5] The model is dynamically simulated and every response variable's simulation or convergence path compared with its baseline path to determine the respective multipliers.

The elasticities of a particular source variable are determined by applying a constant percentage shock to the source variable, i.e. by increasing the source data series with 10 percent from 1975

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[4]   Klein (1983: 135).

[5]   The shocks applied to unskilled labour demand and the unskilled wage rate are only 1 percent where a 10 percent shock was applied for every other stochastic variable in the system.

onwards[6]. Again the model is dynamically simulated and the response variable's convergence and baseline paths are compared to determine the respective elasticities.

These processes are repeated for every stochastic variable in the system – a series of simulations are conducted to determine the matrix of multipliers and elasticities.

From evaluating the results for the dynamic multipliers and elasticities, it is clear that the sample range is too small to always ensure convergence within the sample. A couple of the response variables' multipliers and elasticities did not ambiguously converge within the sample range. For the purpose to facilitate the detection of convergence Hodrick-Prescott filters were applied and the smoothed and actual dynamic multipliers/elasticities graphed and evaluated.

The convergence or long-run (proxied by the last value), as well as the average values for the dynamic multipliers and elasticities are presented in tables 9.3 and 9.4 respectively. The dynamic multipliers and elasticities of every response variable for one particular shock are graphically illustrated. Figures A15.1 to A15.11 in Appendix 15 provide the series of graphical illustrations for every shock applied.

The economic interpretation of some of the significant responses are evaluated in the next chapter where an attempt is made to propose a set of policy rules that will alleviate the unemployment problem in South Africa, i.e. improve the labour absorption capacity of the economy. It is, however, worthy to note at this stage that the obtained long-run properties of the neoclassical supply-side model are consistent with *a priori* expectations.

9.4   CONCLUSION

The purpose of this chapter was to combine each of the individually estimated components into a neoclassical supply-side model and to close the system by introducing a number of identities and definitions that will link the endogenous variables in the system.

Both the single equations and the model as a whole were evaluated in terms of the full ideal principles of model selection (Appendix 3), which in brief are: (1) economic consistency, (2) statistical significance, (3) data adequacy, (4) its being encompassing and (5) its sensitivity.

In particular, the estimated model had to comply with the *a priori* objectives of the study and had to be relevant for both policy analysis and forecasting purposes. The model was dynamically simulated for various scenarios (baseline and numerous shocks) to identify and determine the structural and long-run properties of the neoclassical system.

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[6]   The shocks applied to unskilled labour demand and the unskilled wage rate are again only 1 percent as opposed to the 10 percent for every other stochastic variable in the system.

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It is concluded that the model and its properties comply with both the full ideal principles and *a priori* objectives of the research, and is suitable to be utilised for both policy analysis and forecasting purposes.

Table 9.3   Response properties of the supply-side model (complete system): long-run multiplier[7] and elasticity[8] effects (convergence values)

Response variables		Shocked (source) variables										
		Real GDP at factor cost	Real fixed investment	Nominal corporate savings	Skilled labour demand	Unskilled labour demand	Labour supply	Skilled labour supply	Nominal skilled wage rate	Real unskilled wage rate	Production price index	Consumer price index
Real GDP at factor cost	multiplier	na	0.48	-1.97	4.72	0.44	-0.31	0.01	-18.29	2.68	2.17	-1.67
	elasticity	na	0.10	0.02	0.50	0.09	-0.10	0.001	-0.29	0.59	0.12	-0.09
Real fixed investment	multiplier	0.16	na	-11.40	-1.28	-0.09	-0.02	0.03	-0.02	-2.98	0.41	-1.39
	elasticity	0.61	na	0.09	-1.40	-0.07	-0.03	0.02	-0.21	-3.47	-1.02	-1.46
Nominal corporate savings	multiplier	-0.03	0.02	na	-0.84	0.16	0.03	0.04	0.95	-1.93	0.48	-0.13
	elasticity	-0.20	0.12	na	-2.17	0.41	0.12	0.05	0.006	-4.78	-0.57	-1.73
Skilled labour demand	multiplier	0.03	0.03	-0.93	na	0.05	-0.14	-0.08	0.33	1.63	-0.09	0.14
	elasticity	0.14	0.02	0.003	na	0.04	-0.22	-0.03	-0.42	1.78	0.19	0.11
Unskilled labour demand	multiplier	0.05	0.05	-0.77	0.57	na	-0.02	0.02	-1.68	0.09	0.33	-0.12
	elasticity	0.21	0.05	0.004	0.57	na	-0.03	0.02	-0.25	0.09	0.33	-0.16
Labour supply	multiplier	-0.02	-0.02	-0.03	-0.16	-0.02	na	0.01	0.79	0.15	-0.29	0.25
	elasticity	-0.03	-0.01	-0.002	-0.04	-0.008	na	-0.001	0.11	0.07	-0.38	0.14
Skilled labour supply	multiplier	0.09	-0.07	-0.05	-0.78	-0.61	-0.74	na	5.13	0.71	-0.90	-0.45
	elasticity	0.32	-0.06	-0.02	-0.48	-0.50	-1.04	na	1.21	0.68	-0.02	-0.05
Nominal skilled wage rate	multiplier	-0.03	-0.05	-0.24	-0.31	-0.14	0.13	0.04	na	-0.22	-0.35	0.27
	elasticity	-0.21	-0.09	-0.02	-0.41	-0.20	0.30	0.005	na	-0.37	-0.13	0.87
Real unskilled wage rate	multiplier	0.06	-0.03	0.72	-0.98	-0.37	0.13	0.03	2.51	na	-0.47	0.08
	elasticity	0.21	-0.02	-0.002	-0.74	-0.29	0.16	-0.006	0.46	na	-0.31	0.07
Production price index	multiplier	-0.15	-0.11	-4.78	2.70	0.19	-0.01	-0.03	-1.71	5.60	na	1.89
	elasticity	-0.20	-0.07	-0.02	1.05	0.04	-0.007	0.004	-0.03	2.26	na	0.82
Consumer price index	multiplier	-0.28	-0.22	-1.44	0.03	-0.24	0.06	-0.007	1.60	1.04	-0.76	na
	elasticity	-0.38	-0.09	-0.02	0.05	-0.09	0.03	-0.008	0.15	0.47	0.12	na
Labour participants in the informal sector	multiplier	0.07	0.02	-0.003	0.07	0.006	0.04	-0.004	-0.03	0.004	0.02	-0.01
	elasticity	0.34	0.09	0.005	0.56	0.03	-0.17	-0.001	-0.38	0.02	0.22	-0.07

[7]   An exogenous shock applied to each stochastic variables by increasing the series from 1975 onwards with a constant value. The shocks are equal to 1% of the 1975-observed value for unskilled labour demand and real unskilled wage rate and 10% of the 1975-observed value for every other stochastic variable.

[8]   An exogenous shock applied to each stochastic function by increasing unskilled labour demand and real unskilled wage rate from 1975 onwards with 1%, and increasing each of the stochastic variables from 1975 onwards with 10%.

Table 9.4   Response properties of the supply-side model (complete system): long-run multiplier and elasticity effects (average values)

Response variables		Real GDP at factor cost	Real fixed investment	Nominal corporate savings	Skilled labour demand	Unskilled labour demand	Labour supply	Skilled labour supply	Nominal skilled wage rate	Real unskilled wage rate	Production price index	Consumer price index
Real GDP at factor cost	multiplier	na	0.45	0.70	2.89	0.76	-0.04	0.20	-14.14	1.39	1.18	-1.55
	elasticity	na	0.11	0.02	0.33	0.17	-0.007	0.03	-0.24	0.32	0.07	-0.10
Real fixed investment	multiplier	0.13	na	0.99	-0.97	-0.19	0.01	0.03	-1.54	-2.03	-1.54	-2.25
	elasticity	0.45	na	0.20	-0.84	-0.17	0.03	0.03	-0.23	-2.16	-0.97	-1.05
Nominal corporate savings	multiplier	-0.01	-0.008	na	-0.30	-0.02	-0.005	-0.002	0.24	-0.67	0.03	-0.22
	elasticity	-0.33	-0.11	na	-1.55	-0.24	-0.003	0.006	-0.13	-3.31	-0.65	-1.52
Skilled labour demand	multiplier	0.05	0.06	0.003	na	0.06	-0.04	0.03	-2.86	1.07	0.11	0.06
	elasticity	0.25	0.08	0.02	na	0.08	-0.01	0.06	-0.57	1.42	0.10	0.04
Unskilled labour demand	multiplier	0.04	0.08	0.11	0.33	na	0.007	0.02	-0.88	-0.12	0.37	-0.29
	elasticity	0.14	0.09	0.02	0.28	na	0.02	0.02	-0.10	-0.14	0.22	-0.14
Labour supply	multiplier	-0.008	-0.01	-0.13	-0.02	-0.06	na	-0.02	1.29	0.22	-0.02	0.54
	elasticity	-0.01	-0.005	-0.001	-0.00003	-0.03	na	-0.10	0.10	0.12	0.02	0.14
Skilled labour supply	multiplier	0.06	-0.05	-0.37	-0.17	-0.31	0.30	na	6.21	0.77	-0.48	0.01
	elasticity	0.25	-0.06	-0.01	-0.07	-0.30	1.20	na	0.90	0.92	-0.19	0.08
Nominal skilled wage rate	multiplier	-0.01	-0.02	-0.10	-0.10	-0.05	0.05	0.008	na	-0.04	-0.03	0.35
	elasticity	-0.14	-0.05	-0.01	-0.15	-0.14	0.01	-0.11	na	-0.03	0.15	1.05
Real unskilled wage rate	multiplier	0.05	-0.06	-0.21	-0.61	-0.28	-0.008	-0.04	2.57	na	-0.36	0.19
	elasticity	0.18	-0.05	-0.01	-0.41	-0.22	-0.04	-0.03	0.28	na	-0.16	0.07
Production price index	multiplier	-0.05	0.02	-1.27	1.15	0.21	0.01	0.01	-0.36	2.13	na	1.43
	elasticity	-0.11	0.08	0.01	0.78	0.19	-0.02	-0.008	0.08	1.64	na	0.77
Consumer price index	multiplier	-0.12	-0.07	-0.57	0.06	-0.06	0.02	-0.005	0.93	0.43	-0.13	na
	elasticity	-0.33	-0.03	-0.007	0.10	-0.02	-0.006	-0.02	0.14	0.40	0.29	na
Labour participants in the informal sector	multiplier	0.04	0.01	0.00008	0.03	0.003	-0.01	0.002	-0.03	-0.00005	0.009	-0.008
	elasticity	0.27	0.08	0.01	0.24	0.02	0.03	0.04	-0.30	-0.008	0.11	-0.02

CHAPTER 10

THE SOUTH AFRICAN SUPPLY-SIDE MODEL: CRITICAL POLICY IMPLICATIONS

10.1   INTRODUCTION

The development of a supply-side model of the South African economy will be worthless if it can not be used in an attempt to solve the economy's gravest problem: growing unemployment and ever-increasing poverty.

The unemployment problem will only be alleviated by means of sustainable long-term economic growth and stability, and although aggregate demand and aggregate supply jointly determine the economic growth rate, aggregate supply is the greater force behind the growth process. Expressed in general terms, the economy's output of final goods and services (real income) results from both quantitative and qualitative causes, namely the physical inputs of labour and capital as well as their productivity. From the perspective of the labour force, long-term economic growth holds the promise of more jobs and rising per capita output, real wages and living standards.

The level of unemployment associated with a consistent level of output, can be explained in terms of the structural long-run, or supply-side, properties. The essence of a neoclassical supply-side model is to capture and explain the underlying production structure of the economy, associated with consistent factor demand and price relationships of an economy. The resultant levels of production and employment are forthcoming from firms' decision-making processes, which, in turn, are driven by profit-maximising or cost-minimising goals.

The purpose of this chapter is three-fold:

(i)   to give a brief description of the labour conditions and unemployment problem in South Africa;
(ii)   to identify a set of policy rules (proposals) which may increase the labour absorption capacity of the economy and subsequently reduce the unemployment problem; and
(iii)   to empirically validate the suggested policy rules through a series of dynamic simulations of the estimated supply-side model.

10.2   RISING UNEMPLOYMENT IN SOUTH AFRICA

10.2.1   South Africa's economic growth path: 1970-1995

The growth performance of South Africa stands in sharp contrast to that of other emerging countries such as the Far Eastern "Newly Industrialised Countries" (NICs). The lack of necessary political reform, as well as the adoption of an inward-oriented and protectionist institutional framework during the apartheid era, led to a serious deterioration of the South African economy. Direct control measures, weak export incentives, low real interest rates and an overvalued exchange rate prevailed at the beginning of the 1980s. Given the openness of the South African

economy, the sudden collapse of world commodity prices during the 1980s, along with a serious drought, a prolonged economic recession ensued. The sanctions and disinvestment campaign, which culminated in the debt standstill agreement (1985) and subsequent repayment agreements, halted economic growth and development of an already weak economy.

The result was that the South African economy moved into a low growth equilibrium trap. This trap was caused by huge capital outflows, compelling policy authorities to maintain a surplus on the current account of the balance of payments in order to meet the country's debt repayments. This again caused the adjustment process to turn inward and anti-cyclical. Mostly high, positive real interest rates, exchange controls and low real government investment, characterised the adjustment process of the economy between 1985 and 1993.

This dismal growth performance had several harmful effects, such as negative per capita real growth rates and an increasingly unequal distribution of income. Economic welfare in South Africa, measured in terms of real per capital income, has declined progressively since 1970 (figure 10.1).

Figure 10.1   South Africa's real per capita GDP: 1970-1995 (actual and smoothed values)

Real per capita GDP

Percentage growth in real per capita GDP
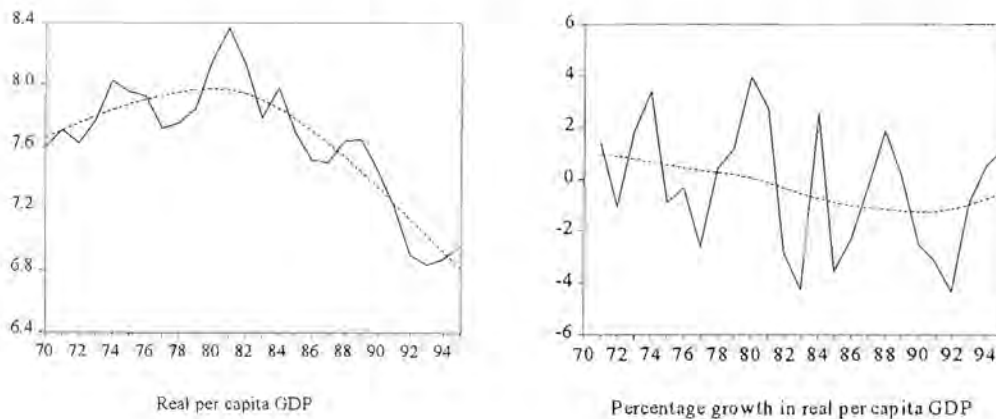
Arguably the most serious of these effects, was the resulting increase in unemployment (figure 10.2).

Figure 10.2   South Africa's unemployment rate: 1970-1995

Unemployment rate

The link between the poor growth performance and the rising unemployment problem is obvious. Less production implies less employment. The severely sub-optimal South African growth performance was however not the only cause of rising unemployment. Structural changes in the production process, such as capital-deepening, and changes in the labour market, such as increased labour militancy, contributed to the magnitude of the problem. This conclusion is supported by the fact that South Africa experienced periods where income growth was small but positive, while employment continued to decline (BEPA 1998).

10.2.2 Labour conditions in South Africa

The fact that high unemployment and insufficient labour absorption remain at the core of South Africa's labour problems, despite periods of positive economic growth, have plagued policy makers, regardless of the type of political dispensation, since the 1970s.

In many countries, labour markets seem to have effectively lost their capacity to perform their allocative, informational and distributional function, and thus become relatively inflexible in adjusting to internal and external shocks to the economy. The main factors seriously influencing the capacity of the economy to adjust to changing circumstances, are interventionist actions by governments, aggressive trade union behaviour, minimum wage arrangements, excessive social security provision, inefficient production and poor management practices, inadequate labour skills and the training of workers, inappropriate production technologies, as well as poor productivity growth.

These characteristics are also present in the South African labour market. The capacity of the formal economy to provide sufficient employment opportunities for its growing labour force has steadily been eroded to the present position where it is virtually extinct. This situation is inflicting an immense cost on society and it also impacts on the socio-economic conditions and political developments in the country.

The labour market displays various inter-related properties that have a direct impact on labour market performance. The labour market conditions are furthermore influenced by several economic and non-economic factors:

(i)   Lack of sustainable (long-term) growth and productivity.

(ii)   Institutional labour conditions have created a rigid labour environment which is detrimental for intensified competition in a global economy and labour-saving technical progress. Examples of these institutional labour market disincentives resulting in inefficient labour markets are: welfare, social security and unemployment payments; high levels of minimum wages; powerful trade unions; extensive regulations governing hours of work, business zones and leave conditions; payroll taxes; job protection laws; difficult and costly dismissal procedures, etc. The affirmative action policy is a particularly detrimental to job creation in South Africa.

(iii)   A deep-seated labour problem relates to the quantity and quality of the potentially available labour force, which are mainly determined by the size and growth of the population, labour force participation rates, hours worked, the level of investment in human capital (education and training), labour mobility (especially migration) and socio-economic conditions.

An analysis performed by the Bureau of Economic Policy and Analysis (BEPA 1998)[1] shows several distinctive trends that impact negatively on the labour absorption capacity of the economy. These trends include the relatively high population growth rate and the major and growing share of young persons in the population, which trends have to be evaluated against the background of a continuously lower real GDP growth rate. The labour force, represented by the economically active population,[2] has increased from 30 percent of the total population in 1960 to 35 percent in 1994. Net migration has added to the strain on the economy's capacity to fulfil the need for jobs. Until the early 1990s, South Africa experienced a substantial net gain in migration, which mainly consisted of high-level or skilled labour. The sanctions and disinvestment campaign against South Africa has, however, contributed to an increasing net loss of high-level labour (the "brain-drain") since the mid-1990s, while the poor economic conditions in South Africa's neighbouring countries have resulted in the influx of poor, unskilled and often illegal immigrants.

This shift in the composition of the labour force has only intensified the problem which has been omnipresent in South Africa's economic history: an abundance of unskilled and a relative shortage of skilled workers.

(iv)   Employment growth has also been constrained by a long-term process of capital deepening. Concomitantly, the capital-output ratio in the South African economy rose substantially (figure 10.3). This has been associated with sharp increases in wages and other labour costs, like those caused by strikes, stayaways and the so-called institutional disincentives mentioned earlier. Labour problems have caused firms to adopt excessively capital-intensive production methods that are obviously detrimental to employment.

(v)   Since 1960, real and nominal earnings per worker have increased by about 2,5 and 12,3 percent per annum respectively, against the background of increasing unemployment. Wage inequalities and wage increases exceeding the inflation rate have contributed to the labour market's inefficiency and the ever-increasing rate of structural unemployment (BEPA 1998).

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[1]   The author of this study participate in research published by the Bureau of Economic Policy and Analysis (BEPA) on "Improving the labour absorption capacity of the South African economy" in 1998. The labour absorption problem was diagnosed, described and key policy proposals were formulated to alleviate the problem. Recognition is herebe given to the findings of the report, which form the basis for the extended and applied research in this chapter.

[2]   The *economically active population* is defined as persons between the ages of 15 and 65 years who are potentially willing and able to take up a job opportunity.

(vi)   Some of the characteristics of the South African socio-economic environment contribute to the weak performance of the economy. These are: a high dependency ratio (1:5) amongst those formally employed; skewed distributions of skills and income; scarcity and an uneven distribution of basic housing, telecommunication, sources of energy and infrastructure across racial and provincial boundaries and an unequal access to and availability of medical services (BEPA 1998).

Figure 10.3   Capital-output ratio for South Africa: 1970-1995
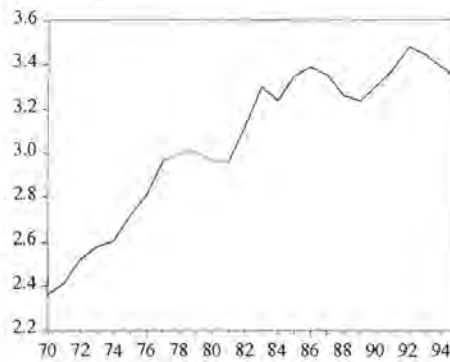
The South African labour market can be divided into two broad segments, namely markets for skilled and markets for unskilled/semi-skilled labour. The skilled labour segment operates according to the general guidelines of the competitive market model. This market showed flexibility to handle and discount demand, supply and external changes and shocks (BEPA 1998).

On the other hand, the unskilled and semi-skilled labour markets, which accommodate the majority of labour-market participants in the economy, are not operating efficiently in terms of their allocative, distributional and informational functions. This market segment appears highly rigid in discounting demand, supply and external changes and shocks. Trade unions and consequently labour legislation contributed to the observed market rigidity.

To summarise, unemployment in South Africa has two major causes: unskilled labour and inflexible markets. To effectively address the massive unemployment problem in the country, these are the issues to attend to.

10.3   THE SOLUTION: PROPOSED SET OF POLICY MEASURES

Unemployment in South Africa displays a non-cyclical pattern, i.e. unemployment rates tend to increase steadily despite periods of relatively high economic growth. Demand-management policies are inadequate to solve the problem. The nature of unemployment increasingly displays structural characteristics and the labour market shows larger imbalances and rigidities.

The labour market has lost its capacity to perform its allocative, informational and distributional functions efficiently. In addition, it has become relatively inflexible in adapting to internal and external shocks to the economy. The main factors influencing the labour market are government

interventionist actions, aggressive trade union activities, minimum wage arrangements, exorbitant social benefit packages of workers, inadequate skills and training of workers, inappropriate production technologies and low productivity. These structural deficiencies have a direct impact on the socio-economic conditions and political developments in the country.

10.3.1 Lessons for South Africa

Based on the experience of successful economies, the labour market plays an important role in determining the success of adjustment and reform, as well as the level of living standards. The labour market and labour policy form part of a dynamic economic system and policy framework, which should meet the conditions for economic growth, development and job creation. These conditions were referred to in the study conducted by the Bureau of Economic Policy and Analysis (BEPA 1998). The conditions briefly are:

(i)   Efficiency in production, which can only be achieved by means of higher rates of growth in manufacturing and exports; faster growth in physical capital, supported by higher rates of domestic saving; and generally higher levels of production.

(ii)   Economic stability by means of disciplined fiscal policy, a stable exchange rate and balance of payments, liberalisation and stabilisation of policy measures and flexible labour markets. Macroeconomic stability will initiate a cycle of high investment rates and strong productivity growth.

(iii)   Correct policy application, i.e. consistency, co-ordination, choice and sequencing of policies, is necessary to facilitate the outward-orientation of economic activity.

(iv)   An economic environment conducive to the attainability of the above three conditions. Such an environment:
-       constitutes a domain within which economic growth, development and job creation flourish;
-       builds the correct infrastructure, develops human resources and the technical and entrepreneurial capabilities to manufacture and export;
-       establishes the institutional basis for growth, namely land reform programmes, housing programmes, assistance to workers and firms and the creation of small- and medium- size business enterprises;
-       is business- and investment-friendly;
-       provides adequate infrastructure;
-       improves education to obtain higher levels of human capital;
-       secures financial institutions;
-       promotes declining fertility; and
-       creates the right climate to sustain flexible labour markets and increased productivity.

A set of conditions with regard to labour markets in particular follows from the successes of the Far Eastern economies:

(i)   Dynamic labour markets that allow free movement of demand and supply to ensure a continuous increase in wage employment.

(ii)   Limited government intervention in labour markets, allowing wages and employment to be determined largely by market forces.

(iii)   Efficient, flexible and responsive labour markets allowing for the rapid adjustment of skills to those in demand, which improves resource allocation across firms and thereby contributes to growth.

(iv)   Limited and small government share in employment.

(v)   Incentive based wage-setting processes (wage-plus-bonus method).

(vi)   Company- or firm-based labour unions.

10.3.2 Policy proposals to increase labour absorption

The labour market in South Africa has not performed its allocative, distributive and informational functions efficiently, as can be seen against the backdrop of the massive structural unemployment in the economy, and the virtual disappearance of the economy's capacity to create jobs for a growing labour force. These shortcomings contribute directly to severe poverty, a very skew distribution of income and other socio-economic inequities. These factors have to be taken into account in any package of policy proposals.

10.3.2.1   Policy proposals based on international experience

From an analysis of the world's successful economies follows that higher economic growth as the driving force behind job creation, is imperative. High and consistent economic growth within a stable macroeconomic environment is of decisive importance and the prerequisite for future employment growth.

Based on the analysis of BEPA (1998), it is clear that an optimal set of policy proposals for sustained growth, development and labour absorption should (1) be based on international experience; (2) focus on the identified labour market inefficiencies; and (3) be aimed at redressing the defects in the socio-economic environment.

Policy proposals based on the lessons from and experiences of other emerging market economies, as well as analysing the growth path of the South African economy, contain of four key elements:

(i)   trade liberalisation, i.e. increased efficiency in production which includes outward-oriented growth (increased exports and world market share) and labour market flexibility;

(ii)   promotion of labour-intensive small and medium-sized enterprises by encouraging entrepreneurial training and opportunities, mechanisms involving SMEs in public projects, deregulation, infrastructure building, etc.;

(iii)   economic (fiscal, monetary and political) stability;

(iv)   environmental development, which requires investment in both physical infrastructure and human capital; and

(v)   labour policy promoting flexible and responsive labour markets.

10.3.2.2   Labour market proposals

For purposes of policy analysis, a framework distinguishing between three categories of policy proposals is specified: (1) labour supply; (2) labour demand; and (3) improvement of the efficiency of the labour market. It should be noted that the separation of these approaches is a theoretical exercise. In practice labour supply, demand and market efficiency are highly interrelated and it is not possible to derive a unique set of policy proposals for any of them independently.

(i)   *Policies focusing on labour supply*

Apart from the relatively high population growth rate that should be halted, the following areas need to be the focus of policy-makers:
-   Market-based land reform and rural development (including agriculture) since a large portion of the total population still lives in rural areas and are to a great extent dependent on agriculture as their source of living.
-   Removal of discriminatory practices.
-   A revised immigration policy addressing the influx of illegal immigrants across South Africa's borders, the loss of high-level manpower due to the political and economic instability and domestic employment of overseas skilled labour.
-   Promotion of investment in human capital to develop skills and upgrade the quality of the labour force.

(ii)   *Policies focusing on labour demand*

The demand for labour and subsequent rate of employment is directly related to the rate of economic growth due to the profit-maximising behaviour of firms. Policy measures to raise the economic growth rate to substantially higher levels are, therefore, of prime importance over the longer term, if job-creation objectives are to be met. A more rapid rate of job-creation will simultaneously alleviate poverty and reduce differences in income distribution and thus materially assist in socio-economic reform.

A higher economic growth level (export-led) would imply changes in the demand for labour and needs to be considered in a set of policy proposals. Export-led production will imply (1) an increasing demand for skilled labour relative to unskilled labour; (2) cost-effectiveness of production in an internationally competitive environment; (3) technically advanced production; (4) improved management techniques; (5) an efficient and cost-effective firm-union negotiation framework; (6) flexibility and stability in the labour market; and (7) involvement of small and medium-sized business firms.

The above-mentioned priorities necessitate the training and retraining of both workers and management, the co-ordination of technology requirements, higher productivity, improved efficiency in wage-setting and bargaining, etc. Generally put, policies must be geared towards the establishment and promotion of more labour-intensive production methods.

(iii)   *Policy approaches to improve the efficiency of the labour market*

The labour market like all other markets in the economy should have the capacity to adjust to any external (and internal) demand and/or supply shock. To fully exploit the opportunities of world markets, the labour market should be able to rapidly discount changing conditions. The economy, workers and employers will all benefit from efficient labour markets.

The efficiency and flexibility of labour markets can be improved if attention is given to:
(1)   the avoidance of excessive wage demands (wage demands in excess of productivity performance);
(2)   the establishment of wage and salary discipline over the longer term to help combat inflation;
(3)   the promotion of competition in all markets and the improvement of labour mobility, removal of *de facto* discriminatory labour practices, continuous upgrading of skills through training and retraining (both employers and workers) and the further liberalisation of foreign trade policies;
(4)   the expansion of investment in human capital to meet the requirement of higher economic growth;
(5)   establishment of voluntary participatory principles in the collective bargaining process;
(6)   the limiting of the demonstration effect of excessive public service remuneration packages on the general economy;
(7)   encouragement of the establishment and functioning of workplace forums;
(8)   the provision of more and timely labour market information;
(9)   to strike an equitable balance between worker and employer rights and responsibilities (e.g. limiting increasing labour costs, i.e. remuneration, stayaway and strike costs, dismissal costs, wage regulation costs, job security provisions, etc.);
(10)   reappraisal of the right to strike and minimising intimidation and victimisation;

(11)　　provision of certain minimum standards in the workplace; workers' rights that must be weighed against the needs of employers and the economy;

(12)　　a re-examination of the effects of centralised minimum wage determination in relation to cyclical and structural economic development.

It follows that there are many facets related to the functioning of the labour market that need the attention of policy-makers. Macroeconomic stability, i.e. a situation where all the real and financial markets in the economy are simultaneously moving towards equilibrium, will create a climate conducive to job-creating economic growth. Presently, the major problem in South Africa is that the labour market is in disequilibrium, whilst the other major markets are showing a greater degree of stability. This situation calls for an appropriate combination and co-ordination of economic policy.

10.3.2.3　　Policy proposals to address the socio-economic environment

The following proposals have emerged as some of the most critical issues to be addressed following the analysis of the socio-economic environment:

(i)　　Mass education and training (investment in human capital), creating a labour force with transferable and advanced skills which can reduce firms' cost of innovation.

(ii)　　Increased investment in housing with associated infrastructure, including electricity and telephones, facilitates the growth of home-based economic activity, which fosters not only informal job opportunities, but also formal small entrepreneurial skills. It could also support adult training programmes through facilitating the learning-by-doing acquisition of transferable skills and improve the employment generating capacity of the construction sector in general and the housing sector in particular.

(iii)　　The promotion of entrepreneurial skills for purposes of human capital building.

(iv)　　Prevention or control of crime and corruption, restoring stability and creating an investment-friendly environment conducive to job-creation.

10.4　　EMPIRICAL VALIDATION OF PROPOSED POLICIES

Policy analysis in this study is conducted within a neoclassical framework and by utilising the structure of the estimated supply-side model of South Africa. For the purpose of testing and evaluating the above-mentioned policy proposals, the proposals are collectively integrated into policy scenarios. Target variables are specified, each representative of a particular policy scenario. A series of dynamic simulations is run by applying exogenous shocks to the target variables to determine their short and long-term effects on particularly labour absorption. Table 10.1 presents the policy proposals tested within particular policy scenarios and the associated target variables employed to simulate and validate the specific set of policy rules (policy scenario).

Table 10.1   Exposition of policy scenarios

Individual policy scenarios			
Scenario	Target variable(s)	Policy proposal(s)	Policy aim
0 Control	demand for skilled labour (n_s); demand for unskilled labour (n_u)	n.a.	n.a.
1 Substitute unskilled for skilled labour demand	demand for skilled labour (n_s); demand for unskilled labour (n_u)	- education and training programmes (environmental development); - greater mobility of labour; - export-led growth; - development of rural areas; - removal of discriminatory practices (e.g. policy of affirmative action); - promotion of a competitive environment; - improved management techniques; - involvement of small and medium-sized firms; - optimise the role of labour unions	- efficiency in production - improved quality of labour supply - improved demand for labour - improved labour market efficiency - improved socio-economic environment - improved economic and political stability
2 Increased education and training	education index (educ_index)	- education and training programmes; - improvement of management skills; - promotion of entrepreneurial skills	- efficiency in production - improved quality of labour supply - improved demand for labour - improved labour market efficiency - improved socio-economic environment - improved economic and political stability
3 Increased financing of investment	corporate saving (sc_cp); personal saving (sp_cp); saving of the general government (sg_cp); net capital flow (netcapfl_cp); change in gold and other foreign reserves (gold_reserv_cp)	- investment and savings-friendly environment (domestic and international); - political stability; - less crime and corruption; - fiscal discipline (lower tax rates); - cost-effective production opportunities	- efficiency in production - improved quality of labour supply - improved demand for labour - improved labour market efficiency - improved socio-economic environment - improved economic and political stability
4 Increased foreign investment (direct and indirect)	total foreign direct investment (dirinvest); total foreign non-direct investment (indinvest)	- investment and savings-friendly environment (domestic and international); - political stability; - less crime and corruption; - cost-effective production opportunities; - relaxation of foreign exchange control policy	- efficiency in production - improved quality of labour supply - improved demand for labour - improved labour market efficiency - improved socio-economic environment - improved economic and political stability
5 Decrease in real unskilled wage rate	real unskilled wage rate (wu_vpi_rat)	- cost-effectiveness of production (e.g. removal of minimum wage policy, lower payroll taxes, less costly dismissal procedures, wage discipline, etc.); - labour market flexibility (e.g. removal of policy of affirmative action); - less union power and militancy; - optimal collective wage bargaining framework; - education and training programmes; - immigration policy favouring skilled labour	- efficiency in production - improved quality of labour supply - improved demand for labour - improved labour market efficiency - improved socio-economic environment - improved economic and political stability

Table 10.1 (*cont.*)

	Individual policy scenarios			
	Scenario	*Target variable(s)*	*Policy proposal(s)*	*Policy aim*
6	Technical innovation	dummy: technology innovation (*tecno_innov*)	- eduction and training programmes; - promotion of investment in human capital (research programmes, etc.); - immigration policy favouring skilled labour; - promotion of international competitiveness	- efficiency in production - improved quality of labour supply - improved demand for labour - improved labour market efficiency - improved socio-economic environment - improved economic and political stability
7	Decreased union power and militancy	union members (*union_members*); strikes and stoppages: man-days lost (*union_work_lost*)	- less union power and militancy	- efficiency in production - improved quality of labour supply - improved demand for labour - improved labour market efficiency - improved socio-economic environment - improved economic and political stability
8	Transition from informal to formal employment	labour participants in informal sector (*n_informal*); demand for skilled labour (*n_s*); demand for unskilled labour (*n_u*)	- education and training programmes (environmental development); - greater mobility of labour; - export-led growth; - development of rural areas; - removal of discriminatory practices (e.g. policy of affirmative action); - promotion of a competitive environment; - improved management techniques; - promotion of small and medium-sized firms; - less union power and militancy	- efficiency in production - improved quality of labour supply - improved demand for labour - improved labour market efficiency - improved socio-economic environment - improved economic and political stability
9	Improved socio-economic conditions	crime index (*crime_index*); education index (*educ_index*); electricity index (*energy_ind*); health index (*health_index*); net transfers received by households (*h_transf_receiv*); per capita disposable income (*income_index*); unemployment benefit (*unpl_ben*)	- less crime and corruption; - education and training programmes; - housing and electricity provision; - improved health services (availability, accessibility, cost and quality); - optimal unemployment benefits; - optimal tax structure	- efficiency in production - improved quality of labour supply - improved demand for labour - improved labour market efficiency - improved socio-economic environment - improved economic and political stability

The dynamic simulation results of the policy scenarios are summarised in table 10.2. A dynamic simulation is run for every policy scenario with a 10 percent shock[3] applied to the particular set of target variables. The response properties of the supply-side model are evaluated by comparing the long-run elasticities (converged percentage difference between the baseline and shocked simulation path) of every response variable with the *a priori* desired policy responses. The averages of the dynamic elasticities (average of the series of elasticities along the simulation path) are also documented as an indication of the short-run dynamic effects of the policy shock. All stochastic variables of the supply-side model were monitored for their responses. Both the comparison between the baseline and shocked simulation paths and the percentage differences (elasticities) along the simulation path between the baseline and shocked variable, are graphically

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[3] A 4 percent shock is applied to scenario 1, i.e. the substitution of unskilled for skilled labour demand.

illustrated for every response variable in a particular scenario. The graphical illustrations for every scenario are provided in figures A16.1 to A16.10 in Appendix 16.

A summary of an evaluation of the results is presented in table 10.3.

The simulation results of the policy proposals were consistent with the desired policy objectives to increase the labour absorption capacity of the economy. However, none of the simulations in isolation led to substantial economic growth. The reason: an increase in employment *ceteris paribus*, will not generate economic growth given the current decreasing returns to scale production structure and without substantial increases in labour productivity. Simulation of the individual policy scenarios suggest that the South African economy is in need of a complete structural reform and individual and isolated policy attempts will not guarantee success. A well-structured and co-ordinated mix of policy rules is needed to obtain the most optimal results, i.e. sustained (long-run) economic growth, development and employment within a stable (political and economic) environment.

For this reason, it is necessary to simulate and evaluate different combinations of the individual policy scenarios to obtain the optimal policy mix that will increase the labour absorption capacity of the economy. The simulation results are presented in table 10.4, the graphical illustrations, similar to those of the individual scenarios, are provided in figures A16.11 to A16.16 in Appendix 16 and a summarised evaluation of the simulation results is documented in table 10.5.

Although every combined policy mix improved both the labour absorption capacity and economic growth rate, the optimal policy mix for increasing the labour absorption capacity is a combination of technical innovation, increased financing for investment, less union power and militancy, the formalisation of the informal sector and improved socio-economic conditions (combined scenario 6). Depending on the secondary priorities, the next choice of policy mix is to include an improvement in socio-economic conditions. Improving the socio-economic conditions raises productivity and wages, but a lower rate of employment in the longer term will have to be tolerated. International experience has proven that exorbitant social benefit packages serve as disincentives and are detrimental to the cause of improved labour market efficiency and employment.

The fact remains that South Africa's unemployment problem will not be efficiently dealt with by ignoring the necessity of structural changes conducive to long-term economic growth development and employment.

10.5   CONCLUSION

The purpose of this chapter was (1) to give a brief description of labour conditions and the unemployment problem in South Africa; (2) to identify a set of policy measures (proposals) that will possibly increase the labour absorption capacity of the economy and subsequently reduce the unemployment problem; and (3) to empirically validate the suggested policy measures through a series of dynamic simulations of the estimated supply-side model.

From analysing the labour market in South Africa, it is clear that it has not performed its allocative, distributive and informational functions efficiently, as may be seen against the backdrop of the massive structural unemployment in the economy, and the virtual disappearance of the economy's capacity to create jobs for a growing labour force.

The main factors that seriously influence the labour market are government interventionist actions, aggressive trade union activities, minimum wage arrangements, exorbitant social benefit packages of workers, inadequate skills and training of workers, inappropriate production technologies and low productivity.

These shortcomings are structural in nature and have a direct bearing on severe poverty, socio-economic inequities, and the very skew distribution of income. These factors have to be taken into account in any package of policy proposals.

A number of policy proposals were suggested, targeting (1) labour supply, (2) demand for labour and (3) the efficiency of the labour market. The proposals were based on international experience and South Africa's growth and employment performance.

The policy proposals were validated by dynamic simulation of the neoclassical supply-side model of South Africa proposed in this study. The proposals were collectively integrated into policy scenarios, target variables were specified, each representative of a particular policy scenario and a series of dynamic simulations were run by applying exogenous shocks to the target variables. The responses of the individual policy scenarios suggest that the South African economy is in need of a complete structural reform and individual and isolated policy attempts will not guarantee success.

A well-structured and co-ordinated mix of policy rules is needed to obtain the optimal results, i.e. sustained (long-run) economic growth, development and employment within a stable (political and economic) environment. For this reason, it was necessary to simulate and evaluate different combinations of the individual policy scenarios.

Depending on priorities, a few combinations of policy proposals were identified that could be employed for South Africa. The optimal policy mix for increasing the labour absorption capacity, was a combination of (1) technical innovation, (2) increased financing for investment, (3) less union power and militancy, (4) the formalisation of the informal sector and (5) an improvement of socio-economic conditions. However, regardless of the policy mix chosen, the message remains clear: in order for South Africa to achieve sustained growth, development and employment, the structural problems of low productivity and inflexible, unresponsive labour markets have to be addressed aggressively.

Table 10.2   Response properties of the supply-side model controlling for different scenarios (policy shocks)

Response variables		0 — Control-Minimum level of unemployment (na)	1 — Substitute unskilled for skilled labour (employment) (4%)	2 — Increased education and training (10%)	3 — Increased financing of investment (10%)	4 — Increased foreign investment (direct and indirect) (10%)	5 — Decrease in real unskilled wage rate (10%)	6 — Technical innovation (10%)	7 — Decreased union power and militancy (10%)	8 — Transition from informal to formal employment (10%)	9 — Improved socio-economic conditions (10%)
Real GDP growth	average % difference	0.2	0.03	0.01	0.02	-0.01	-0.1	0.2	0.0	0.1	0.01
	last % difference	≈0.4	≈0.1	≡0.01	≡0.02	≈0.01	≡-0.1	↑0.4	≈0.0	≡0.1	≈0.0
Real domestic investment	average % difference	-4.0	-3.4	0.04	5.7	0.6	9.5	0.7	0.4	-3.3	-0.4
	last % difference	↓-9.1	↓-4.2	≡0.04	↑6.8	↓-0.04	↑16.6	↑1.2	≈0.5	↓-7.3	↓↑-0.3
Capital-labour ratio	average % difference	-5.0	-2.3	-0.1	2.6	0.7	6.7	-0.3	0.3	-3.6	-0.5
	last % difference	↓-11.1	↓-4.1	↓-0.2	↑4.4	↑↓0.5	↑13.6	↓-0.7	↑0.5	↓-7.8	↓-0.6
Productivity	average % difference	-3.9	-0.8	-0.1	-0.3	0.4	3.1	0.8	0.1	-2.8	-0.2
	last % difference	↓-9.3	↓-1.7	≈-0.2	≡-0.3	↓0.1	↑6.4	↑1.3	↑0.2	↓-6.1	≈-0.3
Nominal corporate savings	average % difference	-8.3	-4.8	-0.2	-0.8	0.2	13.0	-1.7	0.5	-6.8	-0.7
	last % difference	↓-17.9	≈-4.2	≡-0.2	≡-0.8	↑↓-0.3	↑19.4	↓-4.5	↑↓0.4	↓-14.0	↑-0.2
Labour demand	average % difference	control	0.6	0.2	0.4	-0.3	-2.4	0.6	-0.1	2.5	0.2
	last % difference	control	↑1.2	↑0.3	≈0.5	↑-0.1	↓-4.1	↑1.3	↓-0.2	↑4.9	↑↓0.3
Skilled labour demand	average % difference	control	3.9	0.3	0.4	-0.01	-5.8	0.9	-0.2	2.3	0.7
	last % difference	control	↓2.8	↑↓0.2	≈0.4	≈-0.02	↓-7.2	↑1.7	↓↑-0.2	↑4.4	↑↓0.3
Unskilled labour demand	average % difference	control	-2.1	0.03	0.4	-0.5	0.7	0.4	-0.01	2.6	-0.1
	last % difference	control	↑-0.7	↑0.2	≈0.4	↑-0.2	↑↓-0.3	↑0.8	↓-0.1	↑5.6	↑0.2
Labour supply	average % difference	-0.2	0.3	-0.03	-0.02	0.04	-0.6	0.0	-0.02	-0.1	0.01
	last % difference	↓-0.9	↓-0.01	≡-0.03	↓-0.06	↑0.07	↓↑-0.4	↓-0.02	↑0.0	↓-0.3	↓-0.04
Skilled labour supply	average % difference	-2.2	2.3	2.9	-0.3	0.8	-4.0	0.7	-0.2	-1.1	3.4
	last % difference	↓-6.8	↑↓1.2	↑4.4	≈-0.4	≈0.7	↓↑-3.1	↑1.4	↓↑-0.02	↓-3.6	≈4.5
Unskilled labour supply	average % difference	1.3	-1.3	-2.4	0.2	-0.6	2.2	-0.6	0.1	0.7	-2.7
	last % difference	↑3.8	↓↑-1.0	↓-3.7	↑↓0.2	↓↑-0.4	↑↓1.7	↓-1.1	↑↓0.02	↑2.3	≈-3.6
Unemployment	average % difference	control	-0.3	-1.1	-2.8	2.4	7.9	-3.0	0.4	-12.5	-1.1
	last % difference	control	≈-2.9	≈-1.0	↑-1.2	↓0.5	≈8.6	≈-3.0	≈0.4	≈-13.0	↓↑-0.8
Unemployment : skilled labour force	average % difference	control	-12.4	23.6	-6.1	8.3	11.1	-1.1	0.4	-27.1	26.0
	last % difference	control	≈-11.0	↑36.5	≈-6.0	≈6.4	↑28.8	↑↓-1.6	↓↑1.4	↓-64.8	↑36.0
Unemployment : unskilled labour force	average % difference	control	5.0	-11.7	-1.6	0.1	7.2	-3.8	0.4	-7.2	-12.8
	last % difference	control	≈-1.2	↓↑-8.9	≈-0.1	≈-0.8	↑↓4.4	↓↑-3.6	≈0.2	↑-2.2	↓↑-8.5
Real skilled wage rate (cpi deflated)	average % difference	-1.6	-0.5	-0.4	-0.1	0.2	1.8	0.7	0.08	-1.1	-0.4
	last % difference	↓-4.4	≈-1.0	≡-0.4	≈-0.07	↓-0.02	↑3.3	↑1.2	↑0.1	↓-2.8	↓↑-0.3
Real unskilled wage rate (cpi deflated)	average % difference	-2.6	-0.6	0.02	-0.3	0.4	control	0.5	-0.3	-1.9	0.4
	last % difference	↓-6.7	↓-1.2	↓-0.2	↓↑-0.3	↓0.3	control	↑0.9	↑0.06	↓-4.5	↓-0.3
Skilled/Unskilled wage rate ratio	average % difference	1.0	0.08	-0.4	0.1	-0.2	9.6	0.2	0.4	0.8	-0.8
	last % difference	↑2.4	≈0.0	≈-0.3	≈0.2	≈-0.3	↓8.6	↓↑0.4	↓0.1	↑1.7	↓↑0.0
Wage/User-cost-of-capital ratio	average % difference	-2.3	0.1	-0.1	-0.3	0.5	0.4	0.6	0.03	-1.5	-0.1
	last % difference	↓-6.8	↓-1.4	≡-0.1	≈-0.1	↓0.0	↑3.5	↑1.0	↑0.2	↓-4.1	↓-0.3
CPI growth (CPI inflation)	average % difference	0.0	0.04	-0.1	-0.01	0.06	-0.07	-0.1	0.0	0.02	-0.01
	last % difference	≡0.0	≈-0.2	≡-0.1	≈0.0	≈0.0	≈-0.01	≈-0.2	≡0.0	≡0.0	≈-0.01
PPI growth (PPI inflation)	average % difference	0.4	0.2	0.0	-0.01	0.1	-0.5	0.0	-0.02	0.3	0.02
	last % difference	≡0.4	≈-0.1	≡0.0	≈-0.1	≈0.1	≈-0.3	≈0.0	≈0.0	≡0.3	≈-0.1

Key to notation

Symbol	Description
$\approx (a)$	Series is converging on a
$\equiv (a)$	Series is oscillating around a
$\uparrow (a)$	Series is increasing at an increasing rate to a
$\uparrow\text{-}(a)$	Series is decreasing at a decreasing rate to a
$\downarrow (a)$	Series is increasing at a decreasing rate to a
$\downarrow\text{-}(a)$	Series is decreasing at an increasing rate to a
$\uparrow\downarrow(a)$	Series is increasing at an increasing, then decreasing rate to a
$\downarrow\uparrow(a)$	Series is increasing at a decreasing, then increasing rate to a
$\uparrow\downarrow\text{-}(a)$	Series is decreasing at a decreasing, then increasing rate to a
$\downarrow\uparrow\text{-}(a)$	Series is decreasing at an increasing, then decreasing rate to a
control	Variable controlled for in the scenario

Table 10.3   Evaluation of individual policy scenarios

Individual scenario 0: Minimum level of unemployment (Control)

Control variable(s)		$\uparrow n\_s = \min (unempl\_u)$ and $\uparrow n\_u = \min (unempl\_u)$
Responses	Growth	Increased ($\uparrow n$)
	Corporate savings	Decreased due to higher labour cost ($\uparrow n > \downarrow w\_tot$)
	Investment	Decreased due to decreasing corporate savings ($\downarrow fincond\_cp$)
	Capital/labour ratio	Decreased ($\downarrow kap\_r / \uparrow n$)
	Productivity	Decreased ($\uparrow bbp\_90p < \uparrow n$)
	Demand for labour	Controlled for an increase
	Supply of labour	Decreased ($\downarrow w\_u$ and $\downarrow w\_s$)
	Unemployment level	Controlled for a decrease
	Wages	Decreased ($\uparrow n$ but $\downarrow product$)
	Prices	Decrease
Comments		No substantial increase in economic growth unless higher employment is associated with a higher level of productivity

Individual scenario 1: Substitute unskilled for skilled labour demand

Control variable(s)		$\downarrow n\_u = \uparrow n\_s$
Responses	Growth	Increased ($\uparrow n$)
	Corporate savings	Increased on short-run ($\downarrow n < \uparrow w\_tot$), then decreased ($\uparrow n > \downarrow w\_tot$)
	Investment	Decreased ($\downarrow sc\_cp \rightarrow \downarrow fincond\_cp$)
	Capital/labour ratio	Decreased at an increasing rate ($\downarrow kap\_r / \uparrow n$)
	Productivity	Increased on short-run ($\downarrow bbp\_90p > \downarrow n$), then decreased ($\uparrow bbp\_90p < \uparrow n$)
	Demand for labour	Decreased on the short-run (4% $\downarrow n_u > $ 4% $\uparrow n\_s$), then increased ($\downarrow w\_s$, $\downarrow w\_u$ and $\uparrow bbpfact\_90p$)
	Supply of labour	Increased at a decreasing due to higher employment opportunities for skilled labour (the supply of unskilled labour is wage inelastic)
	Unemployment level	Decreased at an increasing rate ($\uparrow n > \uparrow s$)
	Wages	After an initial increase in skilled wages, wages decreased due to decreasing productivity. Skilled wages, however, decreased less than unskilled wages resulting in an increase in the skilled/unskilled wage rate ratio
	Prices	Increased
Comments		No substantial increase in economic growth unless higher employment is associated with a higher level of productivity

Individual scenario 2: Increased education and training

Control variable(s)		$\uparrow educ\_index$
Responses	Growth	Increased ($\uparrow n\_s$ and $\uparrow tecno\_index$)
	Corporate savings	Decreased ($\uparrow n > \downarrow w\_tot$)
	Investment	Increased ($\uparrow bbpfact\_90p$)
	Capital/labour ratio	Decreased ($\downarrow kap\_r / \uparrow n$)
	Productivity	Decreased ($\uparrow bbpfact\_90p < \uparrow n$)
	Demand for labour	Increased ($\downarrow w\_s$, $\downarrow w\_u$ and $\uparrow bbpfact\_90p$)
	Supply of labour	Substantial increase in supply of skilled labour relative to unskilled labour, but decrease in total labour supply due to decrease in wages.
	Unemployment level	Decreased ($\uparrow n > \uparrow s$)
	Wages	Decreased ($\downarrow product$)
	Prices	Decreased
Comments		Increased levels of education do not generate substantial economic growth but induce wage decreases

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Individual scenario 3: Increase financing of investment

Control variable(s)		$\uparrow sc\_cp$, $\uparrow sg\_cp$, $\uparrow sp\_cp$, $\uparrow netcapfl$ and $\uparrow gold\_reserv\_cp$
Responses	Growth	Increased ($\uparrow n$ and $\uparrow kap\_r$)
	Corporate savings	Controlled for an increased
	Investment	Increased ($\uparrow sc\_cp \rightarrow \uparrow fincond\_cp$)
	Capital/labour ratio	Increased at an increasing rate ($\uparrow kap\_r > \uparrow n$)
	Productivity	Decreased ($\uparrow bbp\_90p < \uparrow n$)
	Demand for labour	Increased ($\downarrow w\_u$, $\downarrow w\_s$ and $\uparrow bbpfact\_90p$)
	Supply of labour	Almost no effect
	Unemployment level	Decreased ($\uparrow n$)
	Wages	Decreased ($\downarrow product$)
	Prices	Decreased
Comments		Disappointingly low increase in economic growth. The reasons: (1) South Africa's production structure is labour intensive (any capital increases will have a smaller effect on growth than increases in employment) ; and South Africa produces under conditions of decreasing returns to scale.

Individual scenario 4: Increased foreign investment (direct and indirect)

Control variable(s)		$\uparrow dirinvest$, $\uparrow indinvest$
Responses	Growth	The short-run increase is followed by a decrease due to the capital-intensive nature of foreign investment relative to the labour-intensive production structure of the South African economy ($\downarrow n$ and $\uparrow kap\_r$)
	Corporate savings	Increased due to lower labour cost ($\downarrow n > \uparrow w\_tot$)
	Investment	Increased ($\uparrow sc\_cp \rightarrow \uparrow fincond\_cp$)
	Capital/labour ratio	Increased at an increasing rate ($\uparrow kap\_r > \uparrow n$)
	Productivity	Increased ($\downarrow n$)
	Demand for labour	Decreased due to the capital-intensive nature of foreign investment, as well an increase in wages and lack of economic growth
	Supply of labour	Almost no effect on total labour supply
	Unemployment level	Increased ($\downarrow n$)
	Wages	Increased ($\uparrow product$)
	Prices	Decreased
Comments		An increase in unemployment but again a disappointingly low increase in economic growth. The unemployment problem in South Africa will only be solved if both the supply (increase in skilled relative to unskilled) and demand (economic growth) for labour are addressed.

Individual scenario 5: Decreased real unskilled wage rate

Control variable(s)		$\downarrow wu\_vpi\_rate$
Responses	Growth	Decreased due to the labour-intensive production structure of the South African economy ($\downarrow n$ and $\uparrow kap\_r$)
	Corporate savings	Increased due to lower labour cost ($\downarrow n > \uparrow w\_tot$)
	Investment	Increased ($\uparrow sc\_cp \rightarrow \uparrow fincond\_cp$)
	Capital/labour ratio	Increased at an increasing rate ($\uparrow kap\_r > \uparrow n$)
	Productivity	Increased ($\downarrow n$)
	Demand for labour	Decrease in demand for skilled labour (n_s) and increase in the demand for unskilled labour (n_u), but n_u is relative price-inelastic, while n_s is relative price-elastic. Therefore: $\uparrow n\_u < \downarrow n\_s$, resulting in $\downarrow n$. Other contributing factors are $\uparrow w\_s$, $\uparrow w\_u$ and $\downarrow bbpfact\_90p$
	Supply of labour	Almost no effect on total labour supply
	Unemployment level	Increased ($\downarrow n$)
	Wages	Skilled wages increased ($\uparrow product$) while unskilled wages decreased (controlled)
	Prices	Decreased
Comments		A decrease in unskilled wages relative to skilled wages, result in an increase in the demand for unskilled (unproductive) relative to skilled labour. This again causes a decrease in economic growth.

A minimum wage policy (affecting the demand and supply of unskilled labour), may therefore indeed result in an $\uparrow employment$, since the demand and supply of unskilled labour are price/wage inelastic relative to the demand and supply of skilled labour.

This will only happen in isolation of other policy measures such as the new labour act focusing on affirmative action employment, i.e. the substitution of skilled labour for unskilled labour. |

Individual scenario 6: Technical innovation

Control variable(s)		$\uparrow$ tecno_innov
Responses	Growth	Increased substantially ($\uparrow$ n, $\uparrow$ kap_r and $\uparrow$ product)
	Corporate savings	Decreased due to higher labour cost ($\uparrow$ n and $\uparrow$ w_tot)
	Investment	Increased ($\uparrow$ bbpfact_90p)
	Capital/labour ratio	Decreased ($\uparrow$ kap_r $\uparrow$ n)
	Productivity	Increased ($\uparrow$ bbpfact_90p > $\uparrow$ n)
	Demand for labour	Increased at an increasing rate ($\uparrow$ bbpfact_90p)
	Supply of labour	Increased on the short-term ($\uparrow$ w_s and $\uparrow$ w_u)
	Unemployment level	Decreased ($\uparrow$ n · $\uparrow$ s)
	Wages	Increased ($\uparrow$ product)
	Prices	Decreased
Comments		An increase in the efficiency of production in South Africa will generate economic growth, demand for labour (skilled and unskilled), decrease unemployment, raise the disposable income of workers and reduce inflation.

Individual scenario 7: Decreased union power and militancy

Control variable(s)		$\downarrow$ union_members, $\downarrow$ union_work_lost
Responses	Growth	No change
	Corporate savings	Increased due to lower labour cost ($\downarrow$ n · $\uparrow$ w_tot)
	Investment	Increased ($\uparrow$ sc_cp $\rightarrow$ $\uparrow$ fincond_cp)
	Capital/labour ratio	Increased ($\uparrow$ kap_r and $\downarrow$ n)
	Productivity	Increased ($\downarrow$ n)
	Demand for labour	Increased on the short-run (($\uparrow$ n_u due to $\downarrow$ w_u) · ($\downarrow$ n_s due to $\uparrow$ (w_s/w_u))), then demand for labour decreased (($\uparrow$ product $\rightarrow$ $\uparrow$ w_u $\rightarrow$ $\downarrow$ n_u) and ($\uparrow$ product $\rightarrow$ $\uparrow$ w_s $\rightarrow$ $\downarrow$ n_s)). On average: $\downarrow$ n
	Supply of labour	Decreased ($\downarrow$ w_tot)
	Unemployment level	Decreased on the short-run ($\uparrow$ n and $\downarrow$ s)
	Wages	Decreased on the short-run ($\downarrow$ union_pressure), then increased ($\uparrow$ product)
	Prices	Decreased
Comments		A decrease in labour union power and militancy result in initial higher employment due to lower labour cost.

Individual scenario 8: Transition from informal to formal employment

Control variable(s)		$\downarrow$ n_informal = $\uparrow$ n_u + $\uparrow$ n_s (according to market share)
Responses	Growth	Increased ($\uparrow$ n)
	Corporate savings	Decreased due to higher labour cost ($\uparrow$ n > $\downarrow$ w_tot)
	Investment	Decreased ($\downarrow$ sc_cp $\rightarrow$ $\downarrow$ fincond_cp)
	Capital/labour ratio	Decreased at an increasing rate ($\downarrow$ kap_r and $\uparrow$ n)
	Productivity	Decreased ($\uparrow$ bbp_90p < $\uparrow$ n)
	Demand for labour	Increased at an increasing rate ($\uparrow$ bbpfact_90p and $\downarrow$ w_tot)
	Supply of labour	Decreased ($\downarrow$ w_tot)
	Unemployment level	Decreased substantially ($\uparrow$ n and $\downarrow$ s)
	Wages	Decreased ($\downarrow$ product)
	Prices	Increased slightly
Comments		Again lower than expected growth due to decreasing productivity.

Individual scenario 9: Increased socio-economic conditions

Control variable(s)		$\uparrow$ educ_index, $\uparrow$ energy_ind, $\uparrow$ health_index, $\uparrow$ income_index, $\uparrow$ h_transf_r and $\downarrow$ crime_index
Responses	Growth	Increased ($\uparrow$ n)
	Corporate savings	Decreased due to higher labour cost ($\uparrow$ n > $\downarrow$ w_tot)
	Investment	Decreased ($\downarrow$ sc_cp $\rightarrow$ $\downarrow$ fincond_cp)
	Capital/labour ratio	Decreased ($\downarrow$ kap_r and $\uparrow$ n)
	Productivity	Decreased ($\uparrow$ bbp_90p < $\uparrow$ n)
	Demand for labour	Increased ($\uparrow$ bbpfact_90p and $\downarrow$ w_tot)
	Supply of labour	Almost no change
	Unemployment level	Decreased ($\uparrow$ n)
	Wages	Decreased ($\downarrow$ product)
	Prices	Increased
Comments		Growth is negatively influenced by decreasing productivity; this again the result of production under decreasing returns to scale.

Table 10.4 Response properties of the supply-side model controlling for different scenarios (policy shocks)

Response variables		Combined scenarios					
		1 Technology index, education, foreign investment & innovation	*2* Technology index & financing of investment	*3* Technology index, financing of investment, union power & military	*4* Technology index, financing of investment, union power & military, formalisation of informal employment	*5* Technology index, financing of investment, union power & military, socio-economic conditions	*6* Technology index, financing of investment, union power & military, formalisation of informal employment, socio-economic conditions
Real GDP growth	*average % difference*	0.2	0.2	0.2	0.4	0.2	0.4
	last % difference	↑ 0.4	↑ 0.4	↑ 0.3	≈ 0.7	≈ 0.3	≈ 0.5
Real domestic investment	*average % difference*	1.1	7.0	7.3	3.0	7.0	2.7
	last % difference	≈ 1.1	↑ 8.2	↑ 8.7	↓ -1.2	↑ 8.4	↓ -1.4
Capital-labour ratio	*average % difference*	0.1	2.8	3.1	-1.1	2.8	-1.3
	last % difference	↑↓ -0.5	↑ 3.9	↑ 4.4	↓ -5.3	↑ 4.0	↓ -5.6
Productivity	*average % difference*	1.0	0.7	0.8	-2.2	0.8	-2.3
	last % difference	↓↑ 1.2	↓↑ 1.1	↓↑ 1.3	↓ -5.7	↓↑ 1.2	↓ -5.7
Nominal corporate savings	*average % difference*	-1.8	-2.6	-2.1	-10.0	-2.5	-10.3
	last % difference	↑↓ -4.9	↑↓ -5.5	↑↓ -5.2	↓ -23.3	↑↓ -5.3	↓ -23.4
Labour demand	*average % difference*	0.6	1.0	0.9	3.6	1.0	3.6
	last % difference	↑ 1.5	↑ 1.9	↑ 1.7	↑ 7.7	↑ 1.8	↑ 7.7
Skilled labour demand	*average % difference*	1.3	1.7	1.5	4.1	1.7	4.3
	last % difference	↓↑ 2.0	↑ 2.4	↑ 2.2	↑ 7.6	↑ 2.2	↑ 7.7
Unskilled labour demand	*average % difference*	-0.02	0.4	0.4	3.3	0.3	3.1
	last % difference	↑ 0.8	↑ 1.2	↑ 1.1	↑ 7.8	↑ 1.2	↑ 7.8
Labour supply	*average % difference*	0.01	-0.01	-0.03	-0.1	0.00	-0.09
	last % difference	≈ -0.01	↓ -0.1	↓ -0.08	↓ -0.4	↓ -0.08	↓ -0.4
Skilled labour supply	*average % difference*	4.5	4.3	4.1	2.7	4.2	3.0
	last % difference	↑ 6.4	↑ 6.0	↑ 6.0	↑↓ 1.9	↑ 5.9	↑↓ 1.9
Unskilled labour supply	*average % difference*	-3.6	-3.4	-3.3	-2.3	-3.3	-2.5
	last % difference	≈ -5.0	↓ -4.9	↓ -4.8	↓↑ -2.2	↓ -4.8	↓↑ -2.2
Unemployment	*average % difference*	-2.3	-5.2	-4.8	-18.2	-4.3	-17.7
	last % difference	↓ -3.5	≈ -4.8	≈ -4.4	≈ -20.0	≈ -4.5	≈ -20.0
Unemployment : skilled labour force	*average % difference*	31.0	24.7	25.1	-7.2	23.9	-6.0
	last % difference	≈ 40.0	↑ 33.6	↑ 34.9	↑↓ -42.2	↑ 34.3	↑↓ -42.3
Unemployment : unskilled labour force	*average % difference*	-16.4	-17.9	-17.5	-24.0	-16.0	-23.6
	last % difference	↓↑ -12.8	↓↑ -12.9	↓↑ -12.7	↓↑ -15.5	↓↑ -12.7	↓↑ -15.6
Real skilled wage rate (cpi deflated)	*average % difference*	0.5	0.3	0.4	-0.7	0.4	-0.8
	last % difference	↓↑ 1.2	↓↑ 1.1	↓↑ 1.3	↓ -1.9	↓↑ 1.3	↓ -2.0
Real unskilled wage rate (cpi deflated)	*average % difference*	0.9	0.6	0.3	-1.7	0.7	-1.3
	last % difference	↑↓ 0.8	↑↓ 0.6	↑ 0.6	↓ -4.4	↓↑ 0.6	↓ -4.4
Skilled/Unskilled wage rate ratio	*average % difference*	-0.4	-0.3	0.1	1.0	-0.3	0.6
	last % difference	↓↑ 0.3	↓↑ 0.6	↓↑ 0.7	↓↑ 2.6	↓↑ 0.6	↑ 2.6
Wage/User-cost-of-capital ratio	*average % difference*	0.9	0.6	0.6	-1.0	0.7	-0.9
	last % difference	≈ 0.9	↓↑ 0.8	↓↑ 1.0	↓ -3.5	↓↑ 0.9	↓ -3.5
CPI growth (CPI inflation)	*average % difference*	-0.11	-0.13	-0.13	-0.1	-0.13	-0.1
	last % difference	≈ -0.2	≈ -0.3	≈ -0.2	≈ -0.2	≈ -0.2	≈ -0.3
PPI growth (PPI inflation)	*average % difference*	-0.01	-0.01	-0.02	0.4	-0.02	0.4
	last % difference	≈ 0.03	≈ -0.1	≈ -0.1	≡ 0.4	≈ -0.1	≡ 0.4

Table 10.5 Evaluation of combined policy scenarios

Combined scenario 1: *individual scenarios 2 + 4 + 6*

Policy proposals (shocks)		Improved technology: technical innovation, education and training, and foreign investment (direct and indirect).
Control variables		$\uparrow$ educ_index ; $\uparrow$ dirinvest; $\uparrow$ indinvest and $\uparrow$ tecno_innov
Responses	Growth	Increased ($\uparrow$ kap_r, $\uparrow$ n and $\uparrow$ product)
	Corporate savings	Decreased ($\uparrow$ gostc_cp $\uparrow$ (w_tot × n))
	Investment	Increased ($\uparrow$ rel_wscost_ucc; $\uparrow$ rel_wucost_ucc and $\uparrow$ bbpfact_90p)
	Capital/labour ratio	Increased ($\uparrow$ kap_r $\uparrow$ n)
	Productivity	Increased ($\uparrow$ bbp_90p $\uparrow$ n)
	Demand for labour	Increased ($\uparrow$ bbpfact_90p)
	Supply of labour	Increased supply of skilled labour relative to unskilled labour ($\uparrow$ w_s and $\uparrow$ educ_index)
	Unemployment level	Decreased ($\uparrow$ n $\uparrow$ s)
	Wages	Increased ($\uparrow$ product)
	Prices	Decreased ($\uparrow$ product $\uparrow$ w_tot and $\uparrow$ ucc2_cp)
Comments		Comparing these combined results with those of individual scenarios contributing to an increase in the labour absorption, it is confirmed that increased productivity is a necessary condition for higher employment to contribute to higher growth in a production structure operating under decreasing returns to scale. The raise in productivity was brought about by increased education and training.

Combined scenario 2: *combined scenario 1 + individual scenario 3*

Policy proposals (shocks)		Improved technology: technical innovation, education and training and foreign investment (direct and indirect); and increased investment finance.
Control variables		$\uparrow$ educ_index ; $\uparrow$ dirinvest; $\uparrow$ indinvest; $\uparrow$ tecno_innov; $\uparrow$ sc_cp; $\uparrow$ sg_cp; $\uparrow$ sp_cp; $\uparrow$ netcapfl and $\uparrow$ gold_reserv_cp
Responses	Growth	Increased ($\uparrow$ kap_r, $\uparrow$ n and $\uparrow$ product)
	Corporate savings	Decreased ($\uparrow$ gostc_cp $\uparrow$ (w_tot × n))
	Investment	Increased ($\uparrow$ fincond_cp; $\uparrow$ rel_wscost_ucc; $\uparrow$ rel_wucost_ucc and $\uparrow$ bbpfact_90p)
	Capital/labour ratio	Increased ($\uparrow$ kap_r $\uparrow$ n)
	Productivity	Increased ($\uparrow$ bbp_90p $\uparrow$ n)
	Demand for labour	Increased ($\uparrow$ bbpfact_90p)
	Supply of labour	Increased supply of skilled labour relative to unskilled labour ($\uparrow$ w_s and $\uparrow$ educ_index)
	Unemployment level	Decreased ($\uparrow$ n $\uparrow$ s)
	Wages	Increased ($\uparrow$ product)
	Prices	Decreased ($\uparrow$ product $\uparrow$ w_tot and $\uparrow$ ucc2_cp)
Comments		Investment increased substantially more than in combined scenario1 as a result of the availability of funds for investment. However, it did not have a significant impact on the growth rate due to the labour-internsive nature of the South African production structure.

Combined scenario 3: *combined scenario 2 + individual scenario 7*

Policy proposals (shocks)		Improved technology: technical innovation, education and training and foreign investment (direct and indirect); increased investment finance; and limited labour union power & militancy.
Control variables		$\uparrow$ educ_index ; $\uparrow$ dirinvest; $\uparrow$ indinvest; $\uparrow$ tecno_innov; $\uparrow$ sc_cp; $\uparrow$ sg_cp; $\uparrow$ sp_cp; $\uparrow$ netcapfl; $\uparrow$ gold_reserv_cp; $\downarrow$ union_members and $\downarrow$ union_work_lost
Responses	Growth	Increased ($\uparrow$ kap_r, $\uparrow$ n and $\uparrow$ product)
	Corporate savings	Decreased ($\uparrow$ gostc_cp $\uparrow$ (w_tot × n))
	Investment	Increased ($\uparrow$ fincond_cp; $\uparrow$ rel_wscost_ucc; $\uparrow$ rel_wucost_ucc and $\uparrow$ bbpfact_90p)
	Capital/labour ratio	Increased ($\uparrow$ kap_r $\uparrow$ n)
	Productivity	Increased ($\uparrow$ bbp_90p $\uparrow$ n)
	Demand for labour	Increased ($\uparrow$ bbpfact_90p)
	Supply of labour	Increased supply of skilled labour relative to unskilled labour ($\uparrow$ w_s and $\uparrow$ educ_index)
	Unemployment level	Decreased in total ($\uparrow$ n $\uparrow$ s)
	Wages	Increased ($\uparrow$ product)
	Prices	Decreased ($\uparrow$ product $\uparrow$ w_tot and $\uparrow$ ucc2_cp)
Comments		The greatest contribution of less union power and militancy is lower wage productivity (i.e. lower wages relative to higher productivity), resulting in a lower cost/price structure for the total economy.

Table 10.5 (*cont.*)

Combined scenario 4: *combined scenario 3 + individual scenario 8*

Policy proposals (shocks)		Improved technology: technical innovation, education and training and foreign investment (direct and indirect); increased investment finance; limited labour union power & militancy; and formalisation of informal employment
Control variables		$\uparrow$ *educ_index* ; $\uparrow$ *dirinvest*; $\uparrow$ *indinvest*; $\uparrow$ *tecno_innov*; $\uparrow$ *sc_cp*; $\uparrow$ *sg_cp*; $\uparrow$ *sp_cp*; $\uparrow$ *netcapfi*; $\uparrow$ *gold_reserv_cp*; $\downarrow$ *union_members*; $\downarrow$ *union_work_lost* and $\downarrow$ *n_informal* = $\uparrow$ *n_u* + $\uparrow$ *n_s* (according to market share)
Responses	Growth	Increased ($\uparrow$ *kap_r* and $\uparrow$ *n*)
	Corporate savings	Decreased ($\uparrow$ *gostc_cp* ($\downarrow$ *w_tot* x $\uparrow$ *n*))
	Investment	Increased ($\uparrow$ *fincond_cp* and $\uparrow$ *bbpfact_90p*)
	Capital/labour ratio	Decreased ($\uparrow$ *kap_r* $\uparrow$ *n*)
	Productivity	Decreased ($\uparrow$ *bbp_90p* $\uparrow$ *n*)
	Demand for labour	Increased ($\uparrow$ *bbpfact_90p*; $\downarrow$ w_u and $\downarrow$ w_s)due to $\uparrow$growth
	Supply of labour	Increased supply of skilled labour relative to unskilled labour ($\uparrow$ w_s and $\uparrow$ *educ_index*)
	Unemployment level	Decreased substantially ($\uparrow$ *n* $\uparrow$ *s*)
	Wages	Decreased ($\downarrow$ *product*)
	Prices	Consumer prices decreased and production prices increased ($\downarrow$ *product* $\downarrow$ w_tot and $\uparrow$ *ucc2_cp*)
Comments		Creating formal job opportunities for informal labour participants and thereby reversing the capital-deepening process, will obviously generate economic growth in a labour-intensive production structure. However, the significance of the contribution of more workers to economic growth will depend on their productivity.

Combined scenario 5: *combined scenario 3 + individual scenario 9*

Policy proposals (shocks)		Improved technology : technical innovation, education and training and foreign investment (direct and indirect); increased investment finance; limited labour union power & militancy; and improved socio-economic conditions
Control variables		$\uparrow$ *educ_index* ; $\uparrow$ *dirinvest*; $\uparrow$ *indinvest*; $\uparrow$ *tecno_innov*; $\uparrow$ *sc_cp*; $\uparrow$ *sg_cp*; $\uparrow$ *sp_cp*; $\uparrow$ *netcapfi*; $\uparrow$ *gold_reserv_cp*; $\downarrow$ *union_members*; $\downarrow$ *union_work_lost* ; $\uparrow$ *energy_ind*; $\uparrow$ *health_index*; $\uparrow$ *income_index*; $\uparrow$ *h_transf_r* and $\downarrow$ *crime_index*
Responses	Growth	Increased ($\uparrow$ *kap_r*. $\uparrow$ *n* and $\uparrow$ *product*)
	Corporate savings	Decreased ($\uparrow$ *gostc_cp* $\uparrow$ (w_tot x n))
	Investment	Increased ($\uparrow$ *fincond_cp*; $\uparrow$ rel_wscost_ucc; $\uparrow$ rel_wucost_ucc and $\uparrow$ *bbpfact_90p*)
	Capital/labour ratio	Increased ($\uparrow$ *kap_r* $\uparrow$ *n*)
	Productivity	Increased ($\uparrow$ *bbp_90p* $\uparrow$ *n*)
	Demand for labour	Increased ($\uparrow$ *bbpfact_90p*)
	Supply of labour	Increased supply of skilled labour relative to unskilled labour ($\uparrow$ w_s and $\uparrow$ *educ_index*)
	Unemployment level	Decreased ($\uparrow$ *n* $\uparrow$ *s*)
	Wages	Increased ($\uparrow$ *product*)
	Prices	Decreased ($\uparrow$ *product* $\uparrow$ w_tot and $\uparrow$ *ucc2_cp*)
Comments		Improving socio-economic conditions is a necessary but not sufficient condition for economic growth, development and employment. However, improving the social conditions of especially the formally disadvantaged in South Africa, will ultimately increase the quality of the labour force with the subsequent advantages. It also holds several indirect advantages for the South African economy – one being the political correctness of such a policy, conducive to an investment-friendly environment.

Combined scenario 6: *combined scenario 3 + (individual scenarios 8 + 9)*

Policy proposals (shocks)		Improved technology: technical innovation, education and training and foreign investment (direct and indirect); increased investment finance; limited labour union power & militancy; formalisation of informal employment; and improved socio-economic conditions
Control variables		$\uparrow$ *educ_index* ; $\uparrow$ *dirinvest*; $\uparrow$ *indinvest*; $\uparrow$ *tecno_innov*; $\uparrow$ *sc_cp*; $\uparrow$ *sg_cp*; $\uparrow$ *sp_cp*; $\uparrow$ *netcapfi*; $\uparrow$ *gold_reserv_cp*; $\downarrow$ *union_members*; $\downarrow$ *union_work_lost*; $\downarrow$ *n_informal* = $\uparrow$ *n_u* + $\uparrow$ *n_s* (according to market share); $\uparrow$ *energy_ind*; $\uparrow$ *health_index*; $\uparrow$ *income_index*; $\uparrow$ *h_transf_r* and $\downarrow$ *crime_index*
Responses	Growth	Increased ($\uparrow$ *kap_r* and $\uparrow$ *n*)
	Corporate savings	Decreased ($\uparrow$ *gostc_cp* ($\downarrow$ w_tot x $\uparrow$ *n*))
	Investment	Increased ($\uparrow$ *fincond_cp* and $\uparrow$ *bbpfact_90p*)
	Capital/labour ratio	Decreased ($\uparrow$ *kap_r* $\uparrow$ *n*)
	Productivity	Decreased ($\uparrow$ *bbp_90p* $\uparrow$ *n*)
	Demand for labour	Increased ($\uparrow$ *bbpfact_90p*, $\downarrow$ w_s and $\downarrow$ w_u)
	Supply of labour	Increased supply of skilled labour relative to unskilled labour ($\uparrow$ w_s and $\uparrow$ *educ_index*)
	Unemployment level	Decreased substantially ($\uparrow$ *n* $\uparrow$ *s*)
	Wages	Decreased ($\downarrow$ *product*)
	Prices	Consumer prices decreased and production prices increased ($\downarrow$ *product* $\downarrow$ w_tot and $\uparrow$ *ucc2_cp*)
Comments		The above package of policy rules has proven to be optimal in improving the labour absorption capacity of the economy, raising the quality and therefore productivity of the labour force, and subsequently generating long-run (sustained) economic growth (which in turn is conducive to further employment) in a stable economic environment.

CHAPTER 11

SUMMARY AND CONCLUSION

11.1 INTRODUCTION

Recognition of supply-side fundamentals in economic theory, policy and modelling has become imperative. The deficiencies of demand-oriented theory, policy and models to solve unemployment and inflation discredited the seemingly irrefutable Keynesian principles underlying economic policy for many decades. Their inadequacy to account for and deal with the problems of stagnation, lagging productivity, double-digit inflation, high interest rates and depreciating currencies, led to the emergence of supply-side economics.

Macroeconomic models were criticised for theoretical inconsistency, forecasting failures and inadequate policy analysis and had to adapt to supply-side modelling in the 1970s. Specific consideration was given to the long-run equilibrium properties and stability of models with respect to output, employment and inflation, which in turn crucially depend on the consistency and structure of supply-side specifications. Supply-side properties are modelled in a neoclassical framework, acknowledging the cost-minimising behaviour of firms. The approach adopted by macroeconomic modellers was not one of market clearing in a perfectly competitive environment, but centred around a framework of imperfect competition in goods and labour markets and a bargaining approach to wage determination.

The purpose of the study was to develop a theoretically consistent supply-side model of the South African economy, with the final objective to integrate the supply-side model with a full-sector macroeconomic model of South Africa. The demand-driven macroeconomic model developed by the econometric research team of the University of Pretoria (SAMEM) was used for this purpose.

The study was conducted in three stages:

(i) A description of the theory and background of supply-side modelling, which entailed a thorough investigation of the theoretical principles of supply-side economics and the developments in macroeconomic modelling to coincide with the requirements for theoretical consistency, forecasting and policy analysis in particular. These results are used to evaluate and restructure the demand-driven SAMEM.

(ii) The specification, estimation and validation of a neoclassical supply-side model of the South African economy, encompassing the recent, leading developments in the field such as cost-minimising behaviour, market imperfections and collective bargaining. This involves the derivation and estimation of single equations for production (actual and potential), capacity utilisation, fixed investment, corporate savings, demand for labour (skilled and unskilled), labour supply (total and skilled), wage rates (skilled and unskilled), unemployment (NAWRU) and prices (production and consumption prices).

(iii)   Critical policy implications which resulted from a series of policy scenario simulations of the system of supply-side equations are derived, in order to propose an optimal set of policy measures that will resolve or at least alleviate the severe labour market inefficiencies and related unemployment problem of the South African economy.

11.2   SUPPLY-SIDE ECONOMICS

Although some economists believe supply-side economics to be a modern concept, its origin can be traced back to the classical doctrines of the 1800s and 1900s. Widespread unemployment and the worldwide depression of the 1930s led to the demand-management policies of the Keynesian Revolution, with its rejection of the classical assumptions. Keynesian analysis became the widely accepted foundations of economic policy, but its failure to address and explain the simultaneous occurrence of unemployment and inflation, led to the emergence of supply-side economics and the development of supply-side propositions.

Against this background, the theoretical principles of supply-side economics were explored, as they need to form the basis in the development of a supply-side macro-econometric model of the South African economy. Supply-side effects and particularly the role of taxation, which is the main supply-side instrument, are modelled within a neoclassical framework of profit-maximising or cost-minimising behaviour of firms. These neoclassical principles are adopted in several, different ways by macro-economic modellers. The structural properties of the existing (mainstream) supply-side models are investigated to see how they compare in modelling the neoclassical and associated supply-side principles.

Supply-side modelling has become essential if a macro-econometric model is to be useful for policy analyses beyond short-term forecasting requirements. However, the structure and specification of supply-side models should be such that they are consistent with theoretical principles and that they are successful in forecasting stagflation.

The neoclassical approach can be characterised as a combination of market-clearing and rational expectations and it emphasises the role of stocks rather than flows. The neoclassical approach stresses the supply side of the economy, not through the inclusion of an explicit production function, but rather through a representation of the labour market which is responsive to changes in benefits and taxes, but not to the level of demand. The approach adopted by the mainstream models has not been the competitive paradigm of the classical school; instead, development has centred around a framework of imperfect competition in goods and labour markets and a bargaining approach to wage determination, following the work of Layard and Nickell (1985).

These neoclassical principles are adopted in several, different ways by macro-economic modellers. The structural properties of the existing (mainstream) supply-side models were investigated to see how they compare in modelling the neoclassical and associated supply-side principles. It can be concluded that the Layard-Nickell framework for neoclassical supply-side modelling is consistent with both the theoretical and policy principles of supply-side economics and should form the basis for the development of a consistent supply-side model of the South African economy.

Apart from analysing the theoretical propositions and empirical implications of supply-side economics, the structural properties (demand-driven) and inadequacies of SAMEM had to be identified. A new structure for the South African macroeconomic model was proposed, incorporating a consistent neoclassical supply side and allowing for the principles of the Layard-Nickell framework. A set of neoclassical properties and objectives, as well as a research methodology was identified, which set the boundaries of investigation.

11.3 RESULTS AND IMPLICATIONS

In chapter 4, an aggregate neoclassical production function for the South African economy was estimated and investigated for the long-run properties of the production structure.

The analysis was based on the estimation of a cost function for the South African production sector and the subsequent derivation of a production function based on duality principles. The cost-function approach guarantees theoretical consistency between costs, prices and factor demands in a neoclassical framework. However, only homothetic and linearly separable functional forms, such as the more restricted Cobb-Douglas and CES functions, are self-dual.

It had to be proven, therefore, that the production structure of the South African economy features homotheticity and linear separability, i.e. a constant elasticity of substitution.

In order to test the validity of either a Cobb-Douglas or CES functional form as a representation of the technology in the South African economy, a Translog cost function was estimated and tested for the validity of imposed restrictions. It was proven that the Translog cost function can be converted to a homothetic and linearly separable cost function. By making use of Kmenta's Taylor approximation of the CES function, it was further proven that the function not only exhibits a constant elasticity of substitution, but that it is very close to unity. It is therefore concluded that a Cobb-Douglas functional form may be used as approximation of the production structure of South Africa.

An evaluation of the estimation results obtained from both the Cobb-Douglas and CES functions, revealed a couple of interesting long-run properties of the South African economy. Apart from a unitary elasticity of substitution, which implies that the price ratio dictates the capital-labour ratio, it was concluded that South Africa produces with decreasing returns to scale.

The following important if not surprising properties, may be attributed to the South African production and growth structure:

(i)   Production in South Africa is labour intensive with an output-elasticity of 0.77, stressing the importance of all labour-related issues such as wages, level of skill, the role of labour unions and labour legislation.

(ii)   An interesting feature of the production function is the decreasing returns to scale observed. The Engle-Yoo adjusted returns to scale is 0.85. Returns to scale of 0.85 implies that a 100 percent increase in both the inputs used in the production sector of our

economy will increase production by only 85 percent. This result holds serious consequences for the South African economy. It must be noted that few empirical studies on the aggregate production structure of the total South African economy have been conducted and information for comparative purposes is not readily available.

(iii)   The fact that the Cobb-Douglas production technology is representative of the South African production structure, is confirmation of a unitary elasticity of substitution. The implication of a unitary elasticity of substitution is that the percentage change in the capital-labour ratio is equal to the percentage change in the price ratio.

This is of particular significance in the South African context, since the price ratio dictates the capital-labour ratio. The higher the increase in the price of labour relative to the price of capital, the lower the demand for labour relative to the demand for capital. This confirms the phenomenon in the South African economy of an increasing capital-labour ratio as a result of the rising labour-capital price ratio.

From the above it is clear that South Africa, which has an abundance of relatively expensive unskilled labour, can benefit materially by addressing structural unemployment through education and training. Improved training and education will enhance productivity and ultimately production through both rising employment and technical progress. Increased output growth will, in turn, stimulate the demand for capital (investment), the demand for skilled labour as well as technical progress. The process becomes self-sustaining, as output growth leads to further increases in employment, productivity and, ultimately, again economic growth.

In chapter 5 a measure for potential output and an associated output gap (capacity utilisation) were determined with the objective of incorporating them in an extended supply-side model of the South African economy. Based on the structural nature of the analysis, the preferred measure identified is one based on a production function approach that explicitly takes account of structural information, in particular with respect to the NAWRU.

As a result, potential output was estimated by using an estimated production function for the South African economy. This was done by substituting trend technology, actual capital stock and potential employment into the Cobb-Douglas estimated production function (hapter 4).

Trend technology was obtained by smoothing the endogenously determined technical progress variable (technology index) by applying the Hodrick-Presscott filter. Potential employment was estimated by adjusting the actual labour input in the estimated production function for the gap between actual unemployment and the estimated non-accelerating wage rate of unemployment (NAWRU). The method adopted to measure the NAWRU is based on the assumption that the change in wage inflation is proportional to the gap between actual unemployment and the NAWRU.

The estimation results obtained for the potential output and associated output gap seem plausible given the structural properties and history of the South African economy. The level and trend of

the estimated potential output were validated by comparing the results with a Hodrick-Prescott smoothed series for GDP.

The results obtained for potential output revealed the essence of the impediments on the South African economy - the South African potential to grow is deteriorating. This is due to the sizeable constraint posed by rising labour cost and the resulting continuous increase in unemployment. This declining rate of employment is of a both structural and cyclical nature. A significant part of the South African labour force is unskilled and relatively expensive, while the international tendency towards capital-intensive production requiring more capital, skilled labour and less unskilled workers, has further contributed to the greater degree of capital-intensive production observed in South Africa. Apart from the structural component of unemployment, the growth in GDP has been inadequate to create sufficient job opportunities to cure the unemployment problem. The period of economic sanctions and disinvestment, resulting in the outflow of skilled labour and other consequences, has aggravated the problem.

Chapter 6 aimed to secure a theoretical approach to model aggregate domestic fixed investment. The neoclassical (Jorgenson) approach was selected as the most suitable in estimating fixed investment as it is consistent with a supply-side model for the South African economy, incorporating all cost-minimising and profit-maximising decision-making processes by firms.

The South African economy's vulnerability to international financial market instability has serious implications for domestic fixed investment. It is therefore necessary to incorporate the significant role of financial constraints (internal and external) on investment. An attempt was made to extend the neoclassical specification by incorporating the financial constraints as specified by cash-flow models – only on an aggregate level. Gross domestic investment in South Africa is therefore modelled by a system of equations: a stochastic function for gross domestic fixed investment, identities for the real capital stock and aggregate financial constraints in nominal terms and a stochastic function for nominal corporate savings.

Corporate savings were specified and estimated as a function of after-tax gross operating surplus, i.e. as a function of gross operating surplus adjusted for direct taxes on corporate business enterprises. This is based on the notion that a firm's ability to save is influenced by the utilisation of capacity (activity or production), cost of production in terms of wages and some specification for the user-cost-of-capital (cost/price factors) and additional factors such as taxes, subsidies and depreciation rates. These factors constitute the pre-tax gross operating surplus of the firm, i.e. the pre-tax level of profits.

The dynamic response properties were investigated by applying exogenous shocks to each of the long-run variables separately. In each case, the adjustment path after the initial shock was smooth and the deviation of the new long-run variable from the baseline converged to the expected value as indicated by the magnitude of the estimated elasticity. The performance of the estimated model established itself as a robust mechanism for explaining investment behaviour as an integral part of the South African economy.

In chapter 7 a labour model of the South African economy was developed as part of a neoclassical supply-side of the macroeconometric model. The distinction between skilled and unskilled labour turned out to be very significant in explaining the deficiencies of the South African labour market in general and the structural unemployment problem in particular. At the same time, an attempt was made to model the labour participants in the informal sector, separate from, but with no contemporaneous feedback to formal labour market activities.

Wages and employment were modelled essentially according to a systems approach to ensure consistency in a neoclassical framework. The Layard-Nickell framework of wage bargaining under imperfect competition, emphasising labour market interactions, was utilised. The approach also incorporates the role of labour unions and labour taxes on employers. Although the Layard-Nickell framework is based on a cost-function approach, the decision was made in this study to include a production rather than a cost function in the neoclassical supply-side model. The main reason is to derive an estimate for capacity utilisation – a key component in the price mechanism (structure) of the economy.

Although a Cobb-Douglas production function is included in the model, it was not estimated directly, but derived from an estimated cost function for the South African economy on the basis of Shephard's duality. The direct estimation of a cost function and subsequent derivation of factor demand and price functions ensure consistency in the profit-maximising or cost-minimising decision-making processes of firms.

Each of the estimated components of the labour model proved compliant with both economic and statistical *a priori* conditions. The labour model is therefore established as a robust mechanism in explaining wages and unemployment in the South African economy.

In chapter 8, models for both production (value-added) and consumption prices were proposed, estimated and validated. Consistency is maintained by deriving prices in similar fashion as wages (chapter 7) from an estimated cost function for the South African economy.

Assuming imperfect competition in a neoclassical, profit-maximising framework, firms set their prices as a mark-up on the unit cost of production. Extending on the Layard-Nickell framework, the pricing models estimated in this study do not assume "normal" unit costs, but incorporate the unit costs of capital in addition to labour costs. The estimation results were consistent with the theoretical specification and *a priori* information on the price-setting behaviour of firms.

Regarding inflation in South Africa, the estimated models suggest that (1) wage increases, relative to productivity growth, exert the most pressure on production prices (60 percent) and (2) the consequences of the high degree of openness of the South African economy, represented by a set of international factors, are large contributors to domestic inflation.

The individually estimated components were combined in chapter 9 in a neoclassical supply-side model and the system was closed by introducing a number of identities and definitions that link the endogenous variables in the system.

Both the single equations and the model as a whole were evaluated in terms of the full ideal principles of model selection which briefly are: (1) economic consistency, (2) statistical significance, (3) data adequacy, (4) whether it is encompassing and (5) sensitivity.

In particular, the estimated model had to comply with the *a priori* objectives of the study and had to be relevant for both policy analysis and forecasting purposes. The model was dynamically simulated for various scenarios (baseline and numerous shocks) to determine the structural and long-run properties of the neoclassical system.

It is concluded that the model and its properties comply with both the full ideal principles and *a priori* objectives of the research and is suitable to be utilised for both policy analysis and forecasting purposes.

11.4   CRITICAL POLICY IMPLICATIONS

In the final section of the study, (1) a brief description of the labour conditions and unemployment problem in South Africa was provided; (2) a set of policy measures (proposals) that will possibly increase the labour absorption capacity of the economy and subsequently reduce the unemployment problem was identified; and (3) the suggested policy measures were empirically validated through a series of dynamic simulations of the estimated supply-side model.

The analysis of the labour market in South Africa confirmed that it does not perform its allocative, distributive and informational functions efficiently, as may be seen against the backdrop of the massive structural unemployment in the economy and the virtual disappearance of the economy's capacity to create jobs for a growing labour force.

The factors mainly influencing the labour market, are government interventionist actions, aggressive trade union activities, minimum wage arrangements, exorbitant social benefit packages of workers, inadequate skills and training of workers, inappropriate production technologies and low productivity.

These shortcomings are structural in nature and have a direct bearing on poverty, socio-economic inequities and the distribution of income. These factors have to be taken into account in any package of policy proposals.

A number of policy proposals were suggested, targeting (1) labour supply, (2) demand for labour and (3) the efficiency of the labour market. The proposals were based on international experience and South Africa's growth and employment performance.

The policy proposals were validated by dynamic simulation of the neoclassical supply-side model of South Africa proposed in this study. The proposals were collectively integrated into policy scenarios, target variables were specified, each representative of a particular policy scenario and a series of dynamic simulations were run by applying exogenous shocks to the target variables. The responses of the individual policy scenarios suggest that the South African economy is in

need of comprehensive structural reform; uncoordinated policy attempts will not guarantee success.

A well-structured and coordinated policy mix is needed to obtain optimal results, i.e. sustained (long-run) economic growth and development and employment within a stable (political and economical) environment. For this reason, it was necessary to simulate and evaluate different combinations of the individual policy scenarios.

Depending on priorities, a few combinations of policy proposals were proposed. The most optimal policy mix for increasing the labour absorption capacity, was a combination of (1) technical innovation, (2) increased financing for investment, (3) less union power and militancy, (4) the formalisation of the informal sector and (5) an improvement of socio-economic conditions. However, regardless of the chosen policy mix, the message remains clear: in order for South Africa to achieve sustained growth, development and employment, the structural problems of low productivity and inflexible, unresponsive labour markets have to be addressed aggressively.

11.5 CONCLUSION AND SUGGESTED FURTHER RESEARCH

The serious nature and extent of structural unemployment, a symptom of the labour market inefficiency in South Africa, are of grave concern to economists and policy makers alike. The labour absorption capacity of the economy is far too low to create new job opportunities for the growing economically active population, resulting in increasing hardship and poverty. The South African economy is in dire need of a comprehensive structural make-over and this study has aimed at providing an empirical tool, consistent with neoclassical supply theory and empirical developments, for analysing the structural nature of the problem and providing an optimal set of policy measures.

Most of the unemployed are, however, directly or indirectly involved in the informal sector, in urban as well as rural areas (BEPA 1999). Many of these have very low levels of income and skills, low level of literacy, low self-esteem, squatter housing and very few basic amenities (water, electricity, sanitation, etc.). These people are caught in a poverty trap and their participation in the informal economy is restricted to subsistence activities.

Besides informal subsistence activities which at the basic stages have few job-creation possibilities, there are also economically viable and growth-related activities present in the informal sector. Given the right opportunities, institutional conditions and policies, the latter activities could significantly contribute to the upliftment of the standard of living, promote the human empowerment process and, in particular, create more jobs. Thus, the informal sector provides a temporary haven to the unemployed and destitute (Schoeman and Blignaut 1998).

Against this background, one suggestion for further research is to allow for a contemporaneous feedback from the informal sector, which will improve the policy analysis power of the proposed supply-side model of South Africa.

Another suggestion relates to the estimation technique applied. Further research may be conducted by evaluating the estimation results obtained from the Johansen multivariate cointegration estimation technique relative to the results obtained from the univariate Engle-Granger and Engle-Yoo estimation techniques, particularly in macroeconomic modelling constrained by a small sample range.

In this study an explicit production function was employed, but consistently derived from an estimated cost function with the purpose of deriving a measure for capacity utilisation. Although consistency is ensured within the neoclassical framework, the estimated production structure is restrictive in being of a Cobb-Douglas nature. A more flexible approach, still consistent with cost-minimising, would imply the direct estimation of a transcendental logarithmic (Translog) cost function and consistent derivation and estimation of price and factor demand equations based on Shephard's lemma. This approach is utilised by the London Business School of economics in modelling the supply side of the UK economy. This approach, however, does not allow the derivation of a production function based on duality principles and excludes the derivation of a consistent measure for capacity utilisation, which has important implications for the structure of a macroeconomic model incorporating both demand and supply sides.

A final contribution would be to integrate the proposed supply-side model with the restructured demand-driven macroeconomic model (SAMEM) in a dynamic simulation exercise to evaluate the full spectrum of demand and supply responses.