The potential gross domestic product of South Africa*

By B L de Jager and M M Smal†

Introduction

The maintenance of full employment of production resources, especially labour, is widely recognised as one of the principal objectives of macro-economic policy. However, in a market-orientated economic system policy measures aimed at promoting the employment of labour resources do not necessarily operate directly on employment itself but are mostly designed to influence employment indirectly through their impact on aggregate demand and output. A policy target of full employment of labour therefore requires a target of full employment output.

The potential gross domestic product may be defined as that output which the economy is capable of producing under conditions of full employment of production resources. It may therefore serve as an output target which will ensure full employment of labour, given existing production techniques and the optimal input of capital resources. Potential output also measures the production capacity of the economy and in this respect it also has important policy implications. Short-term policy measures aimed at an unattainable potential output will introduce an inflationary bias into the economy, which could well be detrimental to long-run growth prospects.

The aim of this analysis is to obtain some indication of the output potential of the South African economy during the period 1960 to 1983 and, given certain assumptions about labour force growth, capital accumulation and the savings behaviour of the South African community, to provide an indication of the likely growth rate of the future production potential.

Measurement of potential output

Originally estimates of potential output in the United States of America were based on a simple statistical relationship between the unemployment rate and the gap between potential output and actual output.[1] Subsequently, this relationship became known as Okun's Law. From this so-called law, the following familiar identity can be derived:

$$(1) \quad Q^* = Q(1 + d\,(U - \bar{U})),$$

where Q^* stands for potential output, Q for actual output, U for the unemployment rate, $\bar{U}$ for the unemployment rate associated with full employment and d is a constant indicating the elasticity of potential output with respect to changes in the unemployment rate.

Another well-known procedure to measure potential output is the Wharton trend-through-peaks interpolation method.[2] This method simply connects peak points of a particular output series by linear trend lines which then represent maximum output at all other points in the output cycle. Long-term trend line fitting is also a popular method for determining the growth potential of the economy.[3]

All these methods suffer from certain shortcomings. Okun's method is the only one to incorporate a measure of factor supply, but even in his method the growth in potential output resulting from increases in aggregate factor supplies is not explicitly accounted for. This led him to comment: "Still, I shall feel much more satisfied with the estimation of potential output when ... the capital factor can be taken explicitly into account."[4] Trend line fitting is devoid of any sound economic theoretical rationalisation and can be grossly misleading for the policymaker since structural changes in the trend growth of output will be perceived only after a considerable lapse of time. The trend-through-peaks interpolation method suffers from the same imperfection.

Efforts since 1962 to improve on the original work of Okun have attempted to account for capital resources and for the interaction between actual production and potential production.[5] The major recent development has been to use an approach based upon an aggregate production function.[6]

An aggregate production function

The approach followed in this analysis is to adhere to the usual practice of estimating a functional relationship between output and two production factors, namely labour and capital. The standard assumption is that the production function is homogeneous to degree one and that the functional relationship can be written as:[7]

$$(2) \quad Q_t = F(K_t, L_t),$$

where Q is output, K the effective input of capital re-

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* The concept of potential output should be clearly distinguished from projections published in the Economic Development Programme (EDP) of the Department of Constitutional Development and Planning. The EDP places more emphasis on the *expected actual* economic prospects in the medium as well as the longer term, whereas in this paper an attempt is made to establish the full capacity growth potential of the economy.

† The views expressed and conclusions drawn in this article are those of the authors and do not necessarily represent those of the South African Reserve Bank.

1 Okun, A.M.: "Potential GNP: Its Measurement and Significance", in Smith, W.L. and R.L. Teigen: *Readings in Money, National Income, and Stabilisation Policy*, Richard D. Irwin, Homewood, Illinois, 1974, pp.285-292.

2 Klein, L.R. and R.S. Preston: "The Measurement of Capacity Utilisation", *American Economic Review*, March 1967, pp.34-58.

3 A survey of data-based methods and survey-based methods to measure capacity output is found in Christiano, L.J.: "A Survey of Measures of Capacity Utilisation", *IMF Staff Papers*, March 1981, pp.144-198.

4 Okun, *op. cit.*, p.292.

5 Actual output in conjunction with the investment ratio determine the growth of the capital stock which is the strategic explanatory variable for potential output growth.

6 Rasche, R.H. and J.A. Tatom: "Energy Resources and Potential GNP", *Federal Reserve Bank of St. Louis, Review*, June 1977, pp.10-24.

7 Lancaster, K.: *Introduction to Modern Microeconomics*, Rand McNally, Chicago, 1969, p.73.

sources, L the labour input and the subscript t indicates time periods.

Differentiating equation 2 with respect to time, dividing through by Q and by suitable manipulation of the resulting equation, an expression for the proportional growth rate of Q can be derived:

$$(3)\quad \frac{dQ}{dt} \cdot \frac{1}{Q} = \dot{Q} = E_K\dot{K} + E_L\dot{L},$$

where a dot over a variable indicates a proportional change in that variable,

$$E_K = \frac{\partial F}{\partial K} \cdot \frac{K}{Q} \quad \text{and} \quad E_L = \frac{\partial F}{\partial L} \cdot \frac{L}{Q}.$$ [8]

The dependence of output growth on changes in capital and labour inputs is clearly demonstrated by equation 3. It is evident that for a rise in capital input ($\dot{K}$ positive), output will rise by the product of $\dot{K}$ and E_K. The same applies for growth in labour input when the output rise is given by $\dot{L}$ times E_L. In terms of this formulation it is not realistic to extrapolate output growth with a linear time trend because both capital inputs and labour inputs could increase at variable rates in the long-run. The coefficients E_K and E_L should be recognised as the elasticities of output with respect to changes in input.[9] With L held constant, the elasticity of output with respect to changes in capital input is given by E_K, and with K held constant, the elasticity of output with respect to changes in labour input is given by E_L. The rate of growth in output according to equation 3 is then given by a weighted sum of the growth rates of factor inputs with the respective output elasticities serving as the weights.

The coefficients are also a reflection of the share of output attributable to the respective factor inputs. Assuming profit maximising behaviour and competitive pricing conditions, it can be demonstrated that real factor remuneration is equal to the marginal product of that particular factor input. Therefore,

$$(4)\quad E_L = \frac{\partial F}{\partial L} \cdot \frac{L}{Q} = \frac{WL}{PQ} = \text{share of labour in output},$$

and

$$(5)\quad E_K = \frac{\partial F}{\partial K} \cdot \frac{K}{Q} = \frac{RK}{PQ} = \text{share of capital in output},$$

where W is the nominal wage per unit of labour input, R represents the rental price per unit of capital input and P the price of final output.

The assumption of homogeneity to degree one for the production function implies that the sum of E_K and E_L should be equal to unity. The basic implication of this assumption is constant returns to scale. This means that if all inputs are changed proportionately, output will change in the same proportion. It also assures that the competitively earned shares of output will have a sum equal to one.

A production function which has come into widespread use and which complies with the classical qualities discussed above is the well-known Cobb-Douglas production function which is written as:[10]

$$(6)\quad Q_t = AK_t^{a_1}L_t^{a_2}, \qquad a_1 + a_2 = 1.$$

The coefficients a_1 and a_2 are the output elasticities E_K and E_L, respectively, referred to above and have a sum equal to unity. The Cobb-Douglas production function also exhibits partial elasticities of substitution of unity, which means that an increase in the input of one production factor will result in an equal proportionate decline in the input of the other factor when the output volume is kept constant.[11] A feature often neglected in the analysis of this production function is that the optimum size of the individual firm is indeterminate under conditions of perfect competition.[12] However, in contrast to the short-term behaviour of the individual firm, this may be a valid assumption for the economy as a whole, because in the long-term it is very likely that no limits may exist on the output that the economy can produce, given a growing population and an increasing capital stock.

Output growth from improved efficiency

Attempts to interpret the historical growth pattern of South Africa in terms of equation 3 is sure to fail since the identity will not hold exactly. Unexplained growth will be given by the following expression:

$$(7)\quad \text{Residual growth} = \dot{Q} - a_1\dot{K} - a_2\dot{L}.$$

This residual was referred to by Denison as "the measure of our ignorance".[13] Solow[14] attributed the residual growth to improved efficiency in the production process and reduced the unexplained growth component by allowing A, a constant factor in equation 6, to vary over time.

The constant term A is regarded as a scaling parameter in equation 6 and although it is determined in

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8 Chiang, A.C.: *Fundamental Methods of Mathematical Economics*, McGraw-Hill, New York, 1967, pp.371-382.

9 For a full description of the properties of the neoclassical production function, see Henderson, J.M. and R.E. Quandt: *Microeconomic Theory, A Mathematical Approach*, McGraw-Hill, New York, 1971, pp.52-85.

10 Mayes, D.G.: *Applications of Econometrics*, Prentice-Hall International, Englewood Cliffs, New Jersey, 1981, p.79.

11 Chiang, *op. cit.*, p.381.

12 Samuelson, P.A.: *Foundations of Economic Analysis*, Harvard University Press, New York, 1974, p.78.

13 Denison, E.F.: "The Unimportance of the Embodied Question", *American Economic Review*, March 1964, pp.90-94.

14 Solow, R.M.: "Technical Change and the Aggregate Production Function", *Review of Economics and Statistics*, August 1957, pp.312-320.

statistical estimation by the units of measurement of Q, K and L, it is first and foremost a reflection of the efficiency of the production process. The relevance of efficiency is clearly demonstrated by comparing two identical production functions which differ only in the value of A. For given values of K and L it is obvious that the output level will be higher for the production function with the higher value for A. An important determining factor for the size of A is the skill of the labour force. It can readily be assumed that for two countries with identical labour forces, the one with the higher component of skilled labour will be better equipped to produce a higher output.

In a dynamic world characterised by rapid improvements in technology, it seems unrealistic to assume that the efficiency of production methods would remain unchanged. The improvement in production efficiency should rather be viewed as a continuous process of organisational improvements that shift the production function up through time.[15] The usual practice to take account of these improvements is by introducing a time trend to the production function and substitute for A in equation 6 in the following manner:

$$(8) \quad A_t = A_o e^{gt}$$

Here A_o is a fixed constant but A_t is growing at a smooth rate. The exponential rate of efficiency progress is g which implies that output rises at a rate of g per cent per time period independently of changes in the factor inputs. This type of increase in efficiency is often referred to as disembodied technical progress since it is not associated with measures of capital and labour inputs. It is also regarded as neutral since it leaves the marginal rate of substitution of capital for labour unchanged.

Apart from the influence of technological improvement, upward shifts in the production function can also be brought about by the so-called gains from foreign trade. According to classical economic doctrine, the production efficiency of a closed economy can be improved by entering into trade relations with the rest of the world.[16] Foreign trade can therefore make a substantial contribution to the economic development of a country. It serves as an "engine" for growth insofar as a country specialising according to its comparative advantage and trading at the international exchange ratio, experiences an outward shift in its production frontier, even when it operates under the constraints of fixed factor endowments. These gains are similar to the benefits gained from neutral technological change and can also be represented by upward shifts in the scaling factor of the production function. However, being dependent on international trade conditions, the approximation of the gains from trade by a continuously rising time trend would completely ignore the cyclical nature of international economic developments. For this reason the terms of trade, that is the exchange ratio of South African exports for imports of goods and non-factor services, was used as an approximation for the gains from foreign trade in the regression analysis. Implicit in this approach is the assumption that South Africa specialises according to its comparative advantage and trades at the international exchange ratio.

The inclusion of the terms of trade as an explanatory variable in the aggregate production function can also be rationalised on other grounds. Firstly, in an open economy with a high marginal propensity to import, an improvement in domestic economic activity normally leads to a deficit on the current account of the balance of payments. The ensuing restrictive policy measures aimed at restoring balance of payments equilibrium and preserving the external value of the domestic currency, effectively dampens the prospects for a sustained acceleration in the growth rate. Any long-term improvement in the terms of trade, defined as a rise in export prices in relation to the prices of imported goods and services, will however moderate the policy-induced reduction in the growth rate. Conversely, a long-term weakening in the terms of trade will slow down the rate of increase in aggregate output volume. In addition, uncertainties about factors influencing long-term production planning may multiply as a result of frequent changes in macroeconomic policy measures, in response to changes in the terms of trade, and this variability may act as a further growth inhibiting factor.

Secondly, the inclusion of the terms of trade can also be rationalised by making certain simplifying assumptions about the structure of the economy and by incorporating energy as a third input factor in the production function.[17] Consider a one-commodity economy, highly dependent on imported energy resources, employing a production process described by the following technical relationship:

$$(9) \quad Q_t = A_t K_t^{a_1} L_t^{a_2} E_t^{a_3},$$

where E_t is the input of energy resources in period t with the other symbols maintaining the meaning assigned above. Firms striving to maximise profits under conditions of perfect competition will employ factors of production at rates where the marginal product values of resources equal the price of inputs. More precisely, under these conditions the rate of energy use will be determined by the following relationship:

$$(10) \quad E = a_3 P_q / P_e,$$

where the time subscripts have been omitted and P_q/P_e is the ratio of output price (P_q) to the energy input price

[15] Wynn, R.F. and K. Holden: *An Introduction to Applied Econometric Analysis*, The MacMillan Press, London, 1974, p.58.

[16] Meier, G.M.: *International Trade and Development*, Harper and Row, New York, 1963, p.18.

[17] Rasche and Tatom, *op cit.*

(P_e). By equating the demand for energy derived from the first-order conditions for maximum profit (equation 10) with the actual rate of energy use, the foregoing expression may be used to substitute for E_t in equation 9. By rearranging terms, the equation can be written as:

$$(11)\quad Q_t = (A^*_t K_t^{a_1} L_t^{a_2} P_t^{a_3})^{\frac{1}{1-a_3}},$$

where A^*_t is a new scaling factor and P_t is the inverse of the relative price of energy (P_e/P_q) serving as an indicator of energy use.

Taking into consideration the dominant role of the gold mining industry in the South African economy, the impact of the gold price on the export price index and the importance of oil price changes for the import price deflator, the terms of trade can be interpreted as a measure of output prices relative to energy prices. It may then be argued that the inclusion of the terms of trade in an aggregate production function also serves as an approximation for the rate of energy use in the production process.

The final production function, allowing for changes in the efficiency parameter due to technical progress and the gains from foreign trade, is consequently the following:

$$(12)\quad Q_t = (A_o e^{gt} P_t^{a_3})(K_t^{a_1} L_t^{a_2}).$$

Estimation of the production function

The measure of output for which the production function is estimated, is the output of the business sector. Real output originating in the general government sector is excluded. Strictly speaking, real value added for owner-occupied dwellings and the output of households and non-profit institutions should also be excluded. Owing to problems associated with the statistical identification of these items, they were, however, not excluded from the output data used. In addition, the specific nature of the sector agriculture, forestry and fishing and of the gold mining industry warrants the exclusion of these two sectors from the definition of the business sector. In the case of agriculture, forestry and fishing no reliable quarterly data on employment are available. For the gold mining industry, on the other hand, the supposition of a positive relationship between factor inputs and final output is somewhat distorted by the procedure for estimating real value added. Real value added is estimated as a measure of final output of the gold mines and changes in this quantity may deviate from changes in the tonnage of ore mined by the industry because of changes in the gold content of ore milled. Consequently, increases in factor inputs may lead to an increase in the quantity of ore mined but not necessarily to a rise in gold output. For the purpose of the analysis in this article, the output of the business sector was therefore defined as total real value added, with the exclusion of real value added by agriculture, forestry, fishing, gold mining and general government, but including real value added by public corporations and business enterprises of public authorities.

Time series data for output, employment, the capital stock and the terms of trade are readily available on a quarterly basis. The direct application of linear estimation techniques to the logarithmic version of the production function was restricted by a high degree of multi-collinearity among the variables appearing on the right hand side of equation 12. However, it was demonstrated that under conditions of perfect competition and profit maximisation the parameter a_2 is equal to the output elasticity of labour which is equal to the share of output received by labour (see equation 4 above). Using these properties, the coefficient a_2 was computed as the arithmetic average of the share of output received by labour during the period from 1960 to 1983.[18] The estimated value was 0,58 and there is no reason to reject the hypothesis that labour's share remained constant during the estimation period.[19]

Given the value of a_2 and assuming constant returns to scale, the equation was estimated by using quarterly data, starting in the fourth quarter of 1960 and ending in the fourth quarter of 1983. The output variable Q_t is the real output of the business sector defined above. The employment variable L_t reflects the actual number of people employed in the business sector. This series is compiled on a quarterly basis from various data sources by the Economics Department of the South African Reserve Bank. The real capital stock variable K_t is also computed on a quarterly basis by the Reserve Bank.

It should be mentioned that, for purposes of this article, the real fixed capital stock of private residential buildings was not included in the total capital stock of the business sector. In addition the capital stock was also adjusted for capacity utilisation by using the index of capacity utilisation in the South African manufacturing sector as compiled by the Central Statistical Services. For the period prior to the first quarter of 1971, when this index was not available, an index of capacity utilisation was computed by means of the Wharton trend-through-peaks method of interpolation, referred to above. The official estimates of capacity utilisation were then extrapolated backwards with the aid of this computed index. The variable P_t was taken as the ratio of the price deflator for exports of goods and non-factor services and the price deflator for imports of goods and non-factor services. Due allowance was made for the possibility of time delays between the occurrence of changes in the price ratio and its actual impact on output volumes.

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[18] Klein and Preston used the same procedure to estimate the ratio a_2/a_1. See Klein and Preston, *op. cit.*, p.42.

[19] A time-trend fitted to the quarterly estimates of a_2 had a slope coefficient not significantly different from zero.

The final ordinary least squares estimate for the logarithmic version of the equation is reported below.[20]

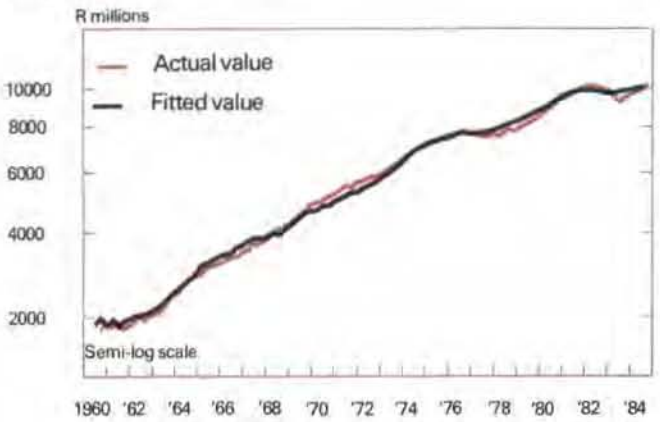
$$(13)\quad \ln Q_t = \underset{}{0{,}58 \ln L_t} + \underset{}{0{,}42 \ln K_{t-1}} + \underset{(1{,}8)}{0{,}00053t}$$

$$+ \underset{(2{,}5)}{0{,}0646 \ln P_{t-3}} + \underset{(185{,}6)}{3{,}3685}$$

$$\bar{R}^2 = 0{,}99$$
$$RH01 = 0{,}86$$
$$RH02 = -0{,}13$$

The goodness of fit of the regression is demonstrated in the accompanying graph.

Output in the business sector



Estimating the potential output volume

Equation 12 can be used to estimate potential output in the South African economy since 1960, when it is supplemented with assumptions concerning the full employment of production resources and the parameter estimates of the preceding section.

The stock of capital resources available during a particular period is essentially the same, irrespective of whether the economy operates at its full potential or not. The rate of capacity utilisation varies, however, with cyclical changes in economic conditions. Consequently, the estimation of potential output of the economy requires some estimate of the rate of capital utilisation that would prevail at potential output. Quarterly estimates of the capacity utilisation index in the manufacturing sector indicate that the 90 per cent utilisation rates achieved during the first quarter of 1974 and again in the third quarter of 1981 represent all-time highs and for lack of any superior indication, 90 per cent was taken as the full employment rate of capital utilisation. To estimate potential output, the value of the capacity utilisation rate was therefore assumed at a level of 0,90 over the entire period from 1960 to 1983.

For the purpose of estimating the full employment rate of labour utilisation, a quarterly series of the overall non-agricultural labour force was constructed from actual employment data, adjusted by the number of registered unemployed White, Coloured and Asian workers and the number of unemployed Black workers as estimated by the Central Statistical Services. For the period prior to the fourth quarter of 1977 when Black unemployment statistics were not available, it was assumed that Black unemployment changed proportionally to the number of registered unemployed White, Coloured and Asian workers.[21] To obtain an indication of the total labour force for the business sector alone, the actual employment numbers for the gold mining industry and the general government were simply subtracted from the estimated non-agricultural labour force. This approach implicitly assumes a high degree of mobility of labour tween the business sector, gold mining and general government. A measure of labour force utilisation associated with full employment, required for computing the output capacity of the business sector, was then estimated by reviewing the ratio of actual employment to total labour force. The all-time high of 90 per cent registered in the fourth quarter of 1981 was taken as an approximation of the utilisation rate associated with the full employment of labour. The potential labour force was then calculated by scaling down the estimated total labour force with a constant proportion of 0,90 representing the full employment unemployment rate.

Substitution of the potential labour force and the fully employed capital stock in equation 13 produced an estimate of the potential output of the business sector. The trend growth rate of the potential output of the business sector between 1961 and 1983 was 4,3 per cent per annum. This growth rate can be decomposed into contributions made by the two production factors (capital and labour), technological progress and the terms of trade. Over the period 1961 to 1983 the potential labour force of the business sector increased on average at a rate of 2,4 per cent per annum and the capital stock by 6,5 per cent. When these growth rates are weighted by the respective factor shares, it turns out that labour contributed about 1,4 percentage points (32 per cent of the overall growth rate) and capital resources 2,7 percentage points (62 per cent of the overall growth rate) to the average annual rate of growth in potential output. The remaining 6 per cent of the overall growth rate stemmed from technological progress and an improvement in

[20] t-statistics are reported in brackets immediately below the estimated coefficients.

[21] Because of recent increases in the number of blacks migrating from rural to urban areas, this may be a rather tenuous assumption. In the absence of any other reliable indicator of Black unemployment it would, however, have to suffice.

the terms of trade. The coefficient of the trend variable in the estimated production function implies an annual growth rate of 0,2 per cent in output as a result of technological improvement or productivity increases. Technological progress contributed therefore only 5 per cent of the average annual increase in potential output, leaving a contribution of just 1 per cent to the long-term improvement in the terms of trade. Undoubtedly, the limited availability of highly skilled labour contributed to the modest rise in output attributable to technological progress.

Although the stability of the terms of trade prevented it from being a sustained growth-promoting factor during the period from 1960 to 1983, it had a pronounced effect on the shorter term changes in output growth. From the end of 1960 to the end of 1967 the terms of trade showed little change but under the impetus of the growing capital stock and labour force growth, coupled with higher utilisation rates, the potential gross output increased at an average annual rate of about 4½ per cent. Over the subsequent period from the end of 1967 to the end of 1974 the terms of trade improved at an annual rate of almost 5 per cent and was partly responsible for potential output growth to accelerate to an annual rate in excess of 5½ per cent. From end 1974 to end 1983 the terms of trade declined by about 2½ per cent per year and this contributed to a slow-down in potential output growth to slightly more than 3 per cent per annum.

The downward shift in potential output growth during the middle of the nineteen-seventies coincided with a similar development in the United States of America. Rasche and Tatom analysed the potential gross national product of the United States and concluded that energy price developments after 1973 reduced potential output by about 4 per cent.[22] A significant downward shift in the industrial production of the seven major trading partners of South Africa also occurred during the middle nineteen-seventies.[23] This may be indicative of a decline in the potential output of these countries following the sharp rise in oil prices in 1973. The South African experience of a decline in potential output after the 1973 oil crisis was therefore not an isolated incident, but formed part of a substantial loss of output potential in several countries. Using the production function to simulate the effect of unchanged terms of trade, it appears that the potential gross domestic product in the business sector was probably more than 1 per cent lower in 1976 than what it could have been if the price of exports relative to the price of imports had maintained its 1973 ratio. Given the average output per worker in the business sector during 1976, this drop in output can be translated into roughly 43 000 job opportunities. Presented in this manner, the significance of changes in the terms of trade for the South African economy is clearly demonstrated.[24]

Forecast of potential output

It has been mentioned above that interaction exists between actual output and potential output. Actual output determines the rate of real fixed investment which affects the rate of growth in the available capital stock. The latter, in turn, serves as an important input in the determination of potential output. This relationship should be taken into account when assessing the future potential output. What is even more important, is the limitations imposed on investment activity by the availability of capital resources. Traditionally, the South African economy could rely upon an inflow of foreign investment to augment the perennial inadequacy of domestic savings. Currently, uncertainties in the international financial environment signify that the future growth of the capital stock would become increasingly dependent upon domestic saving. The aim of this section is to make an assessment of potential output growth under varying assumptions about South Africa's savings ratio. For this purpose, the following skeletal model of the economy was constructed:

$$(14)\quad Q^*_p = A_o e^{gt} K_{-1}^{a_1} L^{a_2} P^{a_3},$$

$$(15)\quad Q = f.v.Q^*_p,$$

$$(16)\quad K = K_{-1} + h.s.\ Q,$$

$$(17)\quad L = L_{-1}(1 + i).$$

Equation 14 is the equation in respect of potential output in the business sector described in the previous section. Equation 15 specifies that aggregate gross domestic product will increase proportionally with potential output in the business sector. The proportion v was based on the average level of the gap between potential output and actual output. In fact, v = 1–u, where u represents the percentage gap between potential and actual output. The proportion f represents the ratio of aggregate output in the domestic economy to real output in the business sector during the ten year period from 1974 to 1983.

In equation 16 the capital stock in the business sector is defined as the sum of the capital stock as at the end of the preceding period and net fixed investment in the

22 Rasche and Tatom, *op. cit.*, p.14.

23 Smit, D.J. and B.E. van der Walt: "Growth trends and business cycles in the South African economy, 1972 to 1981", *South African Reserve Bank Quarterly Bulletin*, June 1982, pp.41-55.

24 It is not the authors' intention to attribute the slow-down in the output growth rate during the second half of the nineteen-seventies solely to changes in the terms of trade. Other exogenous factors, e.g. a reversal of an expansionary fiscal policy stance, the world-wide recession following the 1973 oil price shock and disorderly civilian conduct as manifested in the 1976-riots, may also have contributed to the slower growth in output.

current period (defined as a fixed proportion of real output (Q) in the current period). The net savings ratio, i.e. domestic savings (net of provision for depreciation) as percentage of gross domestic product, is depicted by s, whereas the portion of net domestic investment allocated to the business sector is indicated by h.[25] The net savings ratio plays an important role in the model because it is the crucial factor determining the growth rate of the fixed capital stock.

Equation 17 simply defines the potential labour force of the business sector (L) as a constant growth function. Using as the starting value for potential output in the business sector the computed value for the second quarter of 1984 and assuming a full-employment level of actual output and computing the parameters in equations 15 to 17 as the average proportions observed over the period 1974 to 1983, the model was solved for a forty-quarter period. The average net savings ratio of 14,3 per cent, calculated over the period 1974 to 1983, was substituted for s in equation 16 and the labour force was assumed to continue growing at a constant annual growth rate of 2,5 per cent.

Given these assumptions, together with the assumption of no acceleration in the rate of technological progress and a constant terms of trade, the long-term growth rate of the potential gross domestic product is estimated at 3,6 per cent per annum. In the accompanying table the outcome of alternative model solutions, in which the savings ratio is allowed to vary is also reported. An interesting aspect is that even at a net savings ratio of 17 per cent, which is high in terms of the South African experience since 1974, the estimate of the long-term growth of the South African economy is still less than 4 per cent per annum. To raise the growth potential to a level in excess of 4 per cent without foreign capital investment in South Africa, would require a very high net savings ratio of about 19 per cent which is comparable only with the exceptionally high ratios registered during 1979 and 1980.

Long-term growth rate of potential gross domestic product

Aggregate savings ratio (per cent)	Annual percentage change in potential GDP
11	3,2
12	3,3
13	3,4
14	3,6
15	3,6
16	3,7
17	3,8

[25] Constancy of the net savings ratio implies a gradual rise in the gross savings rate since an increasing proportion of gross savings is required for merely keeping the existing capital stock intact.

Summary

The long-term output growth potential of the South African economy has been analysed with the aid of a neo-classical production function. Taking into account the expected future supply of production resources and assuming a continuation of past trends in technological advancement, a growth rate of between 3½ and 4 per cent per annum seems a fair approximation of South Africa's long-term growth potential. Attempts to raise the growth rate above this limit, without taking measures to increase the long-term savings ratio and/or the rate of productivity growth, will require a sustained inflow of foreign capital and will perpetuate an inflationary bias in the economy. In view of the poor productivity performance during the past two decades, an obvious approach would be to concentrate on a programme of improving productivity growth through increases in the skilled component of the labour force. Past experience has also shown that windfalls in the form of an increase in the relative price of exports, in particular gold, cannot be relied upon to produce a sustained rise in the output potential of the South African economy.