OUTA

ORGANISATION UNDOING TAX ABUSE

October 2018

Theory of Fiscal Policy

Motivation to curb taxation and proposals for reduced Government expenditure and demand on tax revenue

Compiled by OUTA

Input and support from Econometrix

ORGANISATION UNDOING TAX ABUSE NPC

Reg No.: 2012/064213/08

Directors: W Duvenage (CEO), Adv. S Fick, Dr. M Khoza

Non-Executive Directors: F Adam (Chair), P Majozi, W Modisapodi, LP Pauwen, T Pillay Van Graan

ADRESS: O'KEEFFE & Swartz Building, 318 Oak Avenue, Randburg, Gauteng

CONTACTS: 087 170 0639 • info@outa.co.za • www.outa.co.za

Report:

A Fiscal Policy and Fiscal Policy rule for South Africa

September 2018

INTRODUCTION

Background

Current theories[1] on Fiscal Policy are almost invariably based in the idea that a government's objective in developing a budget is, or should be, the maximisation of socio-economic welfare. They begin with idealised assumptions as to how governments should work rather than how the processes of government function in reality. That is, they place governments in the position of autonomous decision makers rather than institutions that are simply attempting to resolve the conflict between the amounts that can be raised through taxation and borrowings and what they are urged or believe necessary to spend. This is the reason why most of them fail in practice[2].

In reality fiscal policy is the approach a government uses to manage the conflict between the resources it has at its disposal and the financial demands placed upon these resources.

Desirable features of any policy are:

1. Debt should be used only to fund assets and activities that would increase or, at least, maintain levels of future tax revenues. This means that current expenditures should never be financed by borrowings.

2. Current taxpayers should neither subsidise nor be subsidised by future taxpayers.

3. The political process should be such that changing a chosen fiscal policy and policy rule should be considerably more difficult than reducing the level of current net expenditure in any particular year. That is, simply ignoring the policy and rule should not be the easiest expedient at the time of budget formulation.

4. Government access to capital markets should be preserved at all times.

The problem addressed in this paper is to design a fiscal policy suitable for South Africa.

Expenditures can be classified into:

1. Responses to constituency demands, such as subsidised housing and services, support for special interests, etc.;

2. Ideological programs, such as income transfers, land restitution, the environment, and global warming;

3. Bureaucratic projects which would include all state-owned enterprises, regulatory bodies and most government agencies;

4. Support for the essential functions of government, such as defence, law and order, and public health;

[1] See for example Portes J, and Wren-Lewis S "Issues in the design of fiscal policy rules": National Institute of Economic and Social Research Discussion Paper No. 429, May 2014.
[2] See Tanzi, V, "Fiscal Policy: When Theory Collides with Reality". Paper presented at the Congress of the International Institute of Public Affairs, Milan August 25 2004.

5. Essential economic supports in the form of capital expenditures that would not otherwise be undertaken, such as infrastructure and education and training.

It would probably be fair to say that the expenditure priorities of most governments are in the order given in the list above.

The first two are those that motivate voters to cast their ballots in favour of one party rather than another. Reductions in these two categories of expenditure are, therefore, usually politically relatively difficult to achieve.

Those in the third category are almost always motivated internally by government bureaucracies on some (usually specious) allegation of "market failure" or "the national interest" and are a species of entrepreneurial activity within the public sector. They are, in principle, the most vulnerable to curtailment, although determined opposition from the managements involved can invariably be anticipated.

Those in the fourth category are quite often underfunded in government budgets to make money available for purposes with higher political/internal priorities.

The fifth category, particularly expenditure on the construction of infrastructure, is often used as a balancing item in a government budget in an attempt to achieve a particular borrowing target. However, it is precisely these expenditures that enable the maintenance and growth of future tax revenues.

Financing of these expenditures is achieved through a combination of taxation and borrowings. Where these fail to close the funding gap governments can resort to asset sales, privatisation and public-private-partnerships.

Since there is no inherent upper limit to the expenditures associated with constituency demands and ideological programs these can only be limited by the money that can be raised through taxation and borrowing. The former is limited by the ability (and willingness) of taxpayers to fund government expenditures and the latter by lenders' concerns with regard to the solvency of the state.

Ultimately, therefore, the willingness of lenders to make further funds available is the only limitation on government expenditure[3].

The purpose of a Fiscal Policy Rule and its objective

"Insolvency" is a condition in which the net amount of funds invested in any enterprise (including governments) exceeds the depreciated value of its assets in service at any time.

Under favourable circumstances governments can operate (and, indeed, have operated) for many decades in the region of insolvency. The more serious state of bankruptcy occurs when the degree of insolvency reached levels that are a cause for alarm among debt providers. At this point they refuse to provide further funds and take steps to recover whatever they can of funds previously made available. It is at this point that a government loses control of its finances.

[3] This neglects the issue of deficit financing by central banks and monetary authorities. In this case the result is a partial default in the form of inflation, and/or more subtly, an appropriation of some of the earnings on interest bearing investment media.

A fiscal policy rule is a set of limitations, expressed either in the form of ratios between financial quantities or as absolute amounts, under which a government limits both its expenditure and the amount it allows itself to borrow in any year.

The purpose of a fiscal policy rule is to provide the fiscal authorities with an argument to resist the pleadings of those who would wish to benefit from government largesse in any particular year by placing a limit on the amount of additional debt that may be added to the taxpayers' burden.

The objective is to avoid conditions likely to place the government in a bankruptcy situation.

Fiscal policy rules in leading economies (USA, Euro area) provide little (if any) guidance in this respect. A summary of fiscal policy rules is given in the IMF publication: "Fiscal Rules at a Glance" (March 2017). This covers 96 countries but not South Africa because the South Africa does not, in fact, have a statutory fiscal policy nor a fiscal policy rule. A notable feature of this summary is the similarity of rules across countries and the frequency with which policies and policy rules have been changed.

This suggests that the types of rule that are applied are either dysfunctional or ineffective. The reason for this could well be the fact that currently there has been (until now) no logically coherent theory of fiscal policy covering realistic rather than idealised circumstances. There is, therefore, a need for such a theory.

Approach

The approach adopted in this work begins with the theory of financial policy that was originally developed by TC Stoffberg in 1970[4] and subsequently used for the analysis and design of a financing rule for the then Electricity Supply Commission in South Africa. This was adapted here to cover the case of any revenue generating public or private entity including an independently governed state

This theory was then applied to a small set of financial policies to evaluate the extent to which their application by a government would result in an acceptable state of solvency. This set includes prototypes of policies that are either currently used or have been used by governments in the past.

Finally, a recommended policy rule for South Africa was developed and analysed in greater detail.

Contents of this report

The next section sets out a theory of fiscal policy and fiscal policy rules. This is followed by a number of applications of the theory for a small number of policy rules, including one that is recommended for application in South Africa. A commentary on the applicability of these examples is then given using three different economic scenarios. Then a demonstration of the application of the recommended rule is given based on the National Treasury forecast for the 2019/2020 fiscal year.

[4] The basis of the theory is contained in unpublished internal memoranda: "Analysis and comparison of different financing schemes", 11 June 1970 and "Internal Financing – Comparison between Electricity Act provisions and depreciation at present day cost", 7 July 1977.

Finally the paper ends with a summary and conclusion. Appendices A to E give the analytical aspects of the theory and of each of the rules considered.

THEORY

General remarks

The theory outlined below and expanded more fully in Appendix A through to Appendix E applies only to governments operating under conditions of relative stability. It does not deal with situations in which a government needs funds to deal with problems such as in warfare, serious civil conflicts or major national emergencies.

Basic concepts

Expenditures by any economic agent, including a government, can usefully be divided into two classes: those needed to pay for the immediate necessities and wants of the entity in question; and, those needed to pay for assets and activities that can reasonably be expected to produce an income in the future. The first are “Current Expenditures” and the second are “Capital Expenditures”.

Within a national budget all expenditures associated with the expansion of infrastructure and the renewal of infrastructure would qualify as capital expenditures on the grounds that they are necessary for the support future levels of economic output and hence tax revenues. A similar case can be made for including government expenditures on the education and training of the future workforce[5]. The same, however, cannot be said for expenditures on government provided housing, recreational facilities or items such as monuments, unless measures have been found for the beneficiaries of these assets to pay user charges that would, in due course, defray the costs of construction.

Current expenditures include all other costs of operation of a government, including, importantly, interest and loan redemption charges associated with all outstanding debt owed by a government as well as the normal costs of maintenance on infrastructure.

A further concept needed in the development of this theory is that of “Assets in Service”. In the case of physical infrastructure, this means all those items that have been implemented at any time in the past and remain in use (i.e. that have not yet been demolished, sold, scrapped or abandoned). In the case of the workforce, this means all the inhabitants of the country who have entered and remain in gainful employment (however defined) and who pay taxes in one form or another.

Assumptions

Two important assumptions were made in the development of this theory.

The first is that the chosen policy has been applied over an indefinite period. The second is that economic conditions within the economy are relatively stable and can be expected to

[5] This refers to post-schooling education and training for vocational skills development. Expenditure on schooling is a function of population numbers and the age structure and is not, in itself, caused by the requirements that an economy places on its workforce.

remain so indefinitely. These makes it possible to produce closed-form analytical solutions for the relationships between the various variables involved.

Both assumptions can be relaxed, but then relationships between variables can be described only with the use of numerical procedures.

Elements of the theory

Elements of the theory comprise:

1. The quantities of infrastructure brought into service during each year. These would be items such as kilometres of roads, bridges, capacity of wastewater treatment plants, etc., together with the weighted average unit costs for each class of infrastructure. These elements allow the amounts to be spent in each year to be calculated.

2. The numbers of people in each occupational category entering the workforce in each year, plus the weighted average costs of education and training given to people in each category. This enables the total cost of education and training of new entrants to be estimated. The theory does not take account of ongoing training of the existing workforce.

3. The weighted average service life of infrastructure installed and, similarly, the weighted average working life of people in the labour force. These, together with the annual expenditures associated with infrastructure and the workforce enable the total asset value of the country to be estimated. (This neglects natural resource endowments and assumes that the value is equal to the total historical cost of the infrastructure in service and the total historical cost of education and training of those still in the workforce).

4. Three macro-economic parameters: the real rate of growth in output; the rate of inflation; and, the interest rate.

It is assumed that the real growth and inflation rates in the economy rate apply equally to both the quantities of infrastructure and the numbers of people required in the workforce. This is not necessarily true and does not take into account the effects of productivity improvements (capital and labour) through time. This assumption is a simplification that could be relaxed in the analysis, but is retained here to avoid complications of little value.

A further observation with respect to the macro-economic parameters is that, ordinarily, the real rate of growth and the rate of inflation have some persistence in a stable economy, Interest rates on the other hand, subject to monetary effects are less stable and can vary quite widely from year to year depending, not only on internal developments but also on developments in international capital markets and trade flows.

Fundamental relationships

Under conditions of steady growth and inflation there exists a constant relationship between capital expenditure on infrastructure in each year and the associated asset base of an economy. This relationship depends on the nominal rate of growth in the economy and is given by the following function:

$$H_t = I_t . \frac{(1-(gp)^{-n})}{(1-(gp)^{-1})} \quad ..(1)$$

where:

- H_t represents the total historical cost of infrastructural assets in service in the year *t*;
- I_t is the investment made in year *t*;
- g is the growth rate in the economy, expressed as the ratio between the output in any year and that of the previous year of the current year(i.e. the percentage growth is (*g*-1) x 100);
- p is the rate of inflation, also expressed as a ratio; and,
- n is the weighted average expected service life of the infrastructural assets.

Alternatively, in order to increase and preserve the productive capacity of an economy, the expenditure on infrastructure should be:

$$I_t = H_t . \frac{(1-(gp)^{-1})}{(1-(gp)^{-n})} \quad ..(2)$$

Equally, the expenditure on education and training of the workforce needs to be:

$$T_t = W_t . \frac{(1-(gp)^{-1})}{(1-(gp)^{-b})} \quad ..(3)$$

where:

- T_t represents amount spent on the workforce in the year *t*;
- W_t is the total historical cost of amounts spent made in year *t* in previous years on the current participants in the workforce;
- g is the growth rate in the economy, expressed as the ratio between the output in any year and that of the previous year of the current year(i.e. the percentage growth is (*g*-1) x 100);
- p is the rate of inflation, also expressed as a ratio; and,
- b is the weighted average expected working life of current participants in the workforce.

The derivation of these relationships is given in Appendix A.

General comments

Capital expenditure in any year is the sum of these two amounts, which are in fixed ratios to the sum of previous expenditures and depend only on the nominal rate of growth in the economy. These expenditures have to be financed either by tax revenues or borrowings or by some combination of the two.

There exists a theory known as "The Irrelevance Proposition"[6] that maintains that, as long as an economic entity remains solvent, there is no reason to prefer revenues over borrowings to finance capital expenditure. However, as will be demonstrated in the next section, relying only on tax revenues or only on borrowings to fund government capital expenditures produces dysfunctional outcomes. An optimal, or at least satisfactory, solution is an appropriate balance between these two extremes that uses both funding sources.

Another point worth making is that the value assigned to the real rate of growth may depart from the historical trend in a country that is in a state of development and has the objective of achieving an acceleration in the rate of national output. Then, provided that the population available is sufficient, expenditures should reflect the required rate of growth rather than the trend in historical growth rates. Failure to do so would inevitably frustrate the achievement of this objective.

FISCAL POLICIES AND POLICY RULES

General

Most economic entities distinguish between current costs, which are recorded in an Income Statement, and capital costs, which are recorded in a Balance Sheet. Current costs are further distinguished between operational expenditures and capital related charges that include items such as depreciation, rentals, accrued interest and dividends.

Governments do not normally distinguish between current expenditures and capital expenditures[7]. Instead the main objects of interest are total expenditures, total tax revenues and the deficit or surplus that arises (usually cash). There is no equivalent of a Balance Sheet or separate recognition of capital related charges, other than a statement of outstanding loans and the interest arising thereon, together with a statement of guarantees issued and other contingent liabilities.

There is, therefore, no easily measurable equivalent of solvency that can be used to judge the financial health of a government. Instead, the ratio of outstanding debt to GDP is used as

[6] Modigliani, F, and Miller, M H, "The Cost of Capital, Corporation Finance, and the Theory of Investment" ***American Economic Review,*** VO1.XLVIII, No.3, (June 1958)

[7] The South African Government does, in fact, make this distinction but does not seem to make any use of the information.

a substitute[8]. This is not of much use because the level of GDP is not, in itself, a measure of the ability of a government to pay interest nor to repay its outstanding debt obligations.

Use of marginal analysis is a more appropriate approach. Here the merits or otherwise of any given policy are judged on the basis of the burden associated with capital expenditures placed on the taxpayers and the relative magnitude of borrowings in the current year These are then compared with a chosen alternative bench-mark policy.

Four policy rules were considered:

1. The Cash Purchase rule;
2. The Chinese Emperor's rule;
3. Queen Victoria's rule; and,
4. The Depreciation Charge rule.

The names are those given to them by Mr Stoffberg. Despite the fanciful terminology, all except, perhaps, the last are applied in some form or another by contemporary governments.

The Cash Purchase policy and rule

This is the so-called "Balanced Budget" system in which a government succeeds in covering all its expenses in every year with taxes collected in the same year.

Despite this condition being something that would meet with the approval of many economists and commentators on economic affairs it is not a system that any government would use without compulsion. Reasons for this are: it violates the criterion of inter-generational fairness (current taxpayers effectively subsidise future taxpayers); and, it exhibits an unwise and costly aversion to the use of borrowed funds by refusing to exploit the advantages offered by low and attractive interest rates. Also, it deprives local capital markets of a popular and useful investment class.

Governments operating under the Cash Purchase rule are, ordinarily, those that are functionally bankrupt and have lost their access to credit markets.

A study of this rule is, however, useful in that it represents the maximum amount that should be levied by a responsible government on its taxpayers to fund capital expenditures and provides a benchmark against which the results of any other proposed system can be measured.

An analysis is given in Appendix B.

[8] The "loan to income ratio" used by the banking industry as a measure of creditworthiness for personal consumer loans is an exact parallel.

The Chinese Emperor's policy and rule

It has been said that for many decades, ending only in the early 18th century, that the then Emperor of China found that he was able to finance all of his ambitious public works program without imposing any burden whatsoever on his subjects for the expenses involved

He did this by issuing loans at the beginning of each year in amounts that were not only sufficient to meet his capital needs in the year, but also to cover the interest payable on all previous loans issued, and a further amount to cover the costs of repaying loans that would fall due for redemption during the year.

His system is, thus, the extreme opposite of the Cash Purchase system.

The Emperor was, of course, insolvent, but, at least initially, not immoderately so. At rates of growth, inflation and interest currently prevailing in the Eurozone (around 2%, 4% and 1.5%) the Chinese debt as a percentage of the total historical cost of assets would have been only some 190%. This would be of no particular cause for concern within a European government's treasury nowadays and was similarly regarded in China at the time.

Details of the derivation of the amounts in outstanding debt are given in Appendix C.

The scheme eventually collapsed when interest rates began to rise to levels that exceeded the real rate of growth in output (i.e. when r > g.p)[9]. Lenders were then shocked to discover that the Emperor's debts had reached alarming levels and were, in any case, unpayable.

Sadly, the Emperor lost his head as a result and his cousin was offered the throne against the promise of a more conservative approach to the management of fiscal affairs[10].

Consideration of this rule is important because, stripped of the drama and rigmarole that surrounds the processes and procedures associated with representative government, it is, effectively, the system applied nowadays in many leading economies.

Queen Victoria's policy and rule

A funding rule that was first used in Europe and became popular in the United Kingdom from 1751, onward through the 19th century, and was used most recently in the early part of 20th century[11] involves the government issue of fixed interest rate loans having no redemption

[9] r is the annual rate of interest expressed as a ratio (i.e the percentage rate of interest is ($r - 1$)).

[10] This part of the legend may well be apocryphal. The Emperor of China during this period was Kangxi. Although it is indeed recorded that he never raised taxes and, in fact, reduced taxes, despite carrying out an extensive public works program, he died of an illness in the winter of 1722 to be succeeded by his fourth son. He is remembered with great affection by the Chinese.

[11] In 1923 by Winston Churchill, then Chancellor of the Exchequer.

date[12]. These are called “Consols”[13] in the UK and are ordinarily negotiable on a stock exchange. Consols were, and remain, a reasonably popular form of investment medium among certain investor classes.

Unlike the Chinese Emperor’s system the interest due on Consols is debited to the State Revenue Account and is therefore paid by current taxpayers. Like the Emperor, no provision is made for the repayment of such loans[14].

The Queen Victoria system also results in insolvency, but the degree of insolvency is lower than that of the Chinese Emperor’s system. Using the same parameters as above, the debt expressed as a percentage of the total historical cost of assets in service falls to around 160%. This is a function only of the real rate of growth in capital expenditure and is, of course, unaffected by the interest rate payable on new loans issued. The Queen Victoria system is thus something of an improvement on the Chinese Emperor’s system.

Details of the derivation of the amounts in outstanding debt and interest payments are given in Appendix D.

The objectionable feature of this policy is that current and future taxpayers are expected to pay interest on loans that financed assets that no longer exist or that defrayed expenses that occurred in the distant past. British taxpayers are, thus, still paying for the First World War and even the Napoleonic Wars[15].

The Depreciation Charge policy and rule

In the final analysis the flaw in Queen Victoria’s policy is that it makes no provision for the repayment of debt and leaves it for posterity to solve the problems associated with the resulting insolvency of the State.

One, rather obvious, solution is to provide for user charges to be levied on the future beneficiaries of capital expenditures made during each year that would be sufficient to redeem the associated outstanding debts by the end of the service lives of the assets or the working lives of those educated and trained during each year. The simplest such rule is the Depreciation Charge rule.

---

[12] One of the earliest examples, on which interest is still being paid by its successor-in-title, was issued by a Dutch utility called Lekdijk Bovendams in 1648.

[13] Private sector equivalents are popular in South Africa under the name “Preference Shares”. They are called “Perpetuals” in India and in certain other countries.

[14] However, many Consols carry the condition that they are callable at face value or par. Similarly, Preference Shares or Perpetuals are seldom issued without a provision for redemption or conversion to some other form of security.

[15] This statement should, perhaps, be qualified by the observation that the British Government has effectively defaulted, via progressive currency debasement during much of the 20th century, on most of the real burden to the taxpayer associated with Consols.

Under this rule all interest arising during any year is paid by current taxpayers (as is the case with Queen Victoria's system). A government deficit is allowed and is funded by borrowings. But, taxpayers are expected to make provision for the recovery of the outstanding government debt via a depreciation charge to the State Revenue Account.

The amount of the deficit allowed in any year is found by deducting a charge for the use of assets and for the benefits conferred by government education and training from the proposed capital expenditure for the year.

The user charge is, in turn, calculated on the basis of straight-line depreciation on the historical cost of infrastructure in service plus a similar charge on the historical cost of the education and training previously given to all those in the workforce during that year.

Using the same economic parameters as applied to the Chinese Emperor's and Queen Victoria's system, the state of solvency, measured by the ratio of debt to total historical cost of assets (including human capital), of the government would now be around 48%. It remains a function of the real rate of growth in expenditure and is unaffected by the prevailing rate of interest.

Details of the derivation of the amounts in outstanding debt and interest payments are given in Appendix E.

Commentary

Three scenarios are worth considering in comparing these fiscal policy rules:

1. One that is representative of conditions that have prevailed in the Eurozone (and thus leading economies) over the last ten years;
2. Another using the macro-economic forecast on which the next South African Budget will be based; and,
3. Finally, target parameters that reflect the aspirations of South Africans with respect to levels of growth and inflation.

In practice, the USA and most of the Eurozone operate under a hybrid version the Chinese Emperor's and Queen Victoria's rule. That this has not yet lead them into serious financial difficulty (except for Greece, Italy, Spain and Portugal), is a function of prevailing economic conditions in those regions rather than being attributable to the quality of their policy. The purpose of the first scenario is to show why fiscal conditions in these economies are unstable and explain why they are cause for concern among economic commentators.

The second scenario has been introduced as a caution against the application without careful consideration, of practices applied in foreign economies. It shows that having no policy or imitating foreign practices under economic conditions prevailing at this time in South Africa would be disastrous.

The third scenario reflects the aspirations expressed by the Government, particularly with regard to the growth in GDP considered necessary to clear the backlog in unemployment and the central SARB target for the rate of inflation (between 3 and 6 percent).

The key parameters are given below.

Scenario	Growth (%)	Inflation (%)	Interest (%)
1. Eurozone	2.0	2.0	1.5
2. RSA forecast	2.0	5.5	6.5
3. RSA aspiration	5.0	4.5	5.5

In all cases it was assumed that the weighted average service life of infrastructure and the weighted average working life in the country would be 40 years and 30 years respectively.

Simulation results for these three scenarios are shown on the table below.

Rule	Eurozone (Scenario 1)			RSA forecast (Scenario 2)			RSA aspiration (Scenario 3)		
	Solvency	Charge /cost	Loan /value	Solvency	Charge /cost	Loan /value	Solvency	Charge /cost	Loan /value
Cash Purchase	0.00	1.04	0.00	0.00	1.08	0.00	0.00	1.10	0.00
Chinese Emperor	1.93	0.00	1.56	4.79	0.00	5.07	2.35	0.00	2.40
Queen Victoria	1.65	0.48	1.00	1.23	1.05	1.00	1.14	0.68	1.00
Depreciation Charge	0.48	0.69	0.47	0.66	0.93	0.71	0.72	0.74	0.77

Note that the excess of the Charge/cost ratio over 1.00 for the Cash Purchase system is the result of the assumption that expenditure in any year is financed by taxes raised in the previous year. The excess is attributable to growth and inflation.

The Cash Purchase (Balanced Budget) rule would be an appropriate system under two separate conditions: one in which a government had access to vast resource rents associated with, for example oil or gas extraction; and the other, in which a government had effectively entered bankruptcy and had been obliged to cede management of its fiscal affairs to an external agency such as the IMF.

Otherwise, it violates the principle of fairness in that current taxpayers are expected to fund the costs of benefits to be enjoyed by future taxpayers, and also, results in the absence of government loans in the financial market which could be used as an investment medium for the country's savers. This is the reason why inhabitants of resource rich countries (such as Norway, Saudi Arabia, etc.) find that they have to place their savings in foreign capital markets and are thereby obliged to accept the associated currency risk.

The popularity of Chinese Emperor's rule, in various guises, is explainable by the fact that it enables governments to concede to demands from their constituencies at no apparent cost to the taxpayer. It leaves it to posterity to deal with the consequences.

An interesting feature of this rule is that, although it results in an insolvent government, the extent of its insolvency is stable as long as interest rates remain below the nominal growth rate in tax revenues. With careful monetary policy management, suffering the consequences

can therefore be postponed indefinitely. This is currently the situation in the Eurozone, the UK, the USA and Japan.

It is a completely inappropriate system for developing economies such as South Africa where interest rates often exceed rates of growth in tax revenues. High, to very high, rates of inflation and an eventual descent into bankruptcy, generally sooner rather than later, are the invariable result.

Queen Victoria's system, although some improvement on the Chinese Emperor's system when interest rates are low (as shown on the table above), is a stable system regardless of whether interest rates exceed growth in revenues or not. But, at the levels of interest rates prevailing in South Africa it would result in a refusal by lenders to finance the deficit.

The Depreciation Charge system has the merits that it introduces some measure of inter-generational fairness into the issue of capital expenditure[16], is stable with respect to the key macro-economic variables, regardless of the relative level of interest rates. And, under all conditions studied automatically adjusts to keep the solvency state of a government within acceptable limits. Therefore, a government consistently applying the Depreciation Charge rule need never be concerned about its access to financial markets.

THE DEPRECIATION CHARGE RULE IN SOUTH AFRICA

Budget information used in this section was extracted from the "Budget Review 2018" issued by the National Treasury (21 February 2018). Figures used in all cases refer to the medium-term estimates for the 2019/2020 fiscal year. The data used is summarised on the table below.

Data item	Amount (R billion)	Source table
Revenue	1609.7	Table 1.2 Consolidated fiscal framework
Expenditure	1803.0	Table 1.2 Consolidated fiscal framework
Budget balance	-193.3	Table 1.2 Consolidated fiscal framework
Capital financing requirement	170.9	Table 3.4 Consolidated operating and capital accounts
Post school education and training	119.3	Table 5.5 Consolidated expenditure by function
Borrowings for the year	204.8	Table 7.3 Financing of gross borrowing requirement
Net loan debt	2768.0	Table 7.8 Total national government debt
Debt servicing costs	197.7	Table 7.10 National government debt-service costs
GDP	5390.1	Table 4.2 Budget revenue

[16] A minor reservation to this statement is that actual historical costs are used as a basis for the depreciation charge. This does not allow for the fact of inflation between the time when expenditures are undertaken and the current cost levels of similar expenditures. However, to correct this by basing depreciation on current replacement costs could, even at relatively moderate inflation rates, produce depreciation charges in excess of required expenditures. In this case the Cash Purchase rule would produce a more economical outcome for current taxpayers.

Applying the Depreciation Charge rule to the expenditure projections on infrastructure and on education and training for the next national budget, using the same forecast macro-economic parameters used in the previous section gives the following result:

Item	Amount (R billion)	Remarks
Capital expenditure: On infrastructure On education and training Total	 171 119 290	 As for the National Treasury projection
Depreciation[17]: On infrastructure On education and training Total	 57 50 107	
Allowable fiscal deficit	183	The corresponding Treasury projection is 193.3
Net borrowings for the year	199	The corresponding Treasury projection is 204.8
Net loan debt	2494	The corresponding Treasury projection is 2768
Loan servicing costs	162	The corresponding Treasury projection is 198

There are three technical measures that are commonly used to assess the viability of a funding scheme. These are:

1. The solvency ratio.
2. The capital charge to capital cost ratio
3. The loan to value ratio

What constitutes a safe solvency ratio depends on the variability and predictability of tax revenues and the scope which a government has to increase rates of taxation or reduce discretionary expenditures as and when necessary. Normally, a lender would regard a solvency ratio of around 0.70 as an upper limit. A ratio exceeding 0.85 would be cause for concern.

In cases where a rule results in a capital charge to capital cost ratio is equal to or greater than the corresponding figure for the Cash Purchase system there is obviously no advantage to be gained from the rule. Where this is the case, the country in question would have been better off with a balanced budget.

[17] The depreciation charge for infrastructure is given by applying the ratio $\frac{1}{n}\frac{(1-(gp)^{-n})}{(1-(gp)^{-1})}$ to the corresponding figure for expenditure. The ratio for education and training is similar i.e. $\frac{1}{b}\frac{(1-(gp)^{-b})}{(1-(gp)^{-1})}$ where *n* is the weighted average service life of infrastructure and *b* is the average working life of a representative member of the workforce. The parameters *g* and *p* represent growth and inflation. See Appendix A and Appendix E for derivations of these and the other relationships used to calculate the outputs on this table.

An acceptable loan to value ratio (related to the solvency ratio, but applied to each item of expenditure) is usually also limited to 0.70. Values exceeding 1.00 are regarded as reckless lending.

The customary measures of the government deficit to GDP ratio and total borrowings to GDP ratio have very little, if any, information content. This is because no government has access to the entire GDP of a country and the ability of a government to raise further revenues via taxation depends on the level of existing taxation at any time (i.e. a government appropriating 15% of the GDP in the form of taxation is in a very different position to one attempting to increase taxes in a country already paying 30% of its GDP over to the fiscus).

The key solvency parameters, together with the deficit and debt to GDP ratios (as a matter of interest), are given below:

Item	**Ratio**
Solvency ratio	0.658
Loan to value ratio	0..684
Deficit to GDP	0.036
Debt to GDP	0.463

Thus, there is, perhaps surprisingly, and on the whole gratifyingly, a close correspondence between the results produced by a prudential fiscal policy rule and the projected state of Government finances for the next fiscal year. This makes it possible to easily adopt such a rule without encountering a difficult series of adjustments to do so.

SUMMARY AND CONCLUSIONS

Desirable features of a fiscal policy are that:

1. Debt should be used only to fund assets and activities that would preserve or increase the tax base of an economy;

2. Current taxpayers should neither subsidise nor be subsidised by future taxpayers;

3. Changing or ignoring a policy rule should be politically difficult;

4. Government access to capital markets should be preserved at all times.

A small number of rules were analysed here and one is recommended for use in South Africa (and for countries with a similar socio-economic structure).

This rule is called the Depreciation Charge rule and involves allowing debt funding to be used only for capital expenditure on infrastructure and for vocational education and training of the future workforce. The amount in loans issued in any year should be the difference between these expenditures and depreciation charges reflecting the recovery of previous amounts spent on all infrastructure, still in service, and on the existing workforce.

This rule would satisfy most of the criteria for a satisfactory fiscal policy.

Fortunately, the current state of Government finances would make it relatively easy to adopt this rule.

APPENDIX A: Derivation of fundamental relationships

Parameters

Parameters of the problem are:

1. The time (t) elapsed between any given datum year (t = 0) and any other time, measured in years.
2. The quantities (q_i , i = 1……) of physical items of infrastructure to be taken into service in the datum year t = 0.
3. The unit costs (c_i , i = 1…..) of each item of infrastructure, at the datum year (t = 0), of the physical items of infrastructure taken into service in that year.
4. The weighted average service life (n) of all infrastructural assets, measured in years.
5. The number of persons (l_i , i = 1 …..) entering the workforce in the datum year (t = 0,)
6. The amount invested in the education and training (a_i , i = 1 ….) of each person who entered the workforce in the datum year (t = 0).
7. The weighted average working life (b) of individuals within the workforce, measured in years.
8. The rate of inflation (p) applicable to all prices in the economy expressed as a ratio (i.e. the annual percentage rate of inflation would be (p – 1) x 100).
9. The real growth rate in the economy (g), expressed as the ratio between the national output (GDP) in any year and that produced during the previous year. (i.e. the annual percentage growth rate would be (g - 1) x 100).
10. The nominal rate of interest (r) on government borrowings, again expressed as a ratio.

Fundamental relationships

The quantity of each class of infrastructure that is in service in the year t is given by the original quantity in service in the datum year increased by the growth in infrastructure needed to support the national output in the current year. That is:

$$Q_i = q_i \,.\, g^t \quad ..(A1)$$

The quantity that was installed to support the growth in output during that year is:

$$q_i \,.\, g^t - q_i \,.\, g^{t-1} = q_i \,.\, g^t \,.\, (1 - g^{-1}) \quad ..(A2)$$

However, this does not include the replacement of infrastructure that was installed for growth n years previously and reached the end of its service life at the beginning of year t. Nor does it include assets that were themselves replaced n years before that, and so on. Therefore, as long as growth has been positive over time, the total quantity of infrastructure installed for replacement is given by:

$$q_i \,.\, (1 - g^{-1}).\, (g^{t-n} + g^{t-2n} + g^{t-3n} \ldots.) = \frac{q_i . g^t . (1 - g^{-1})}{(g^n - 1)} \quad ..(A3)$$

By addition, the total quantity of infrastructure in class i taken into service in year t is then given by:

$$q_i . g^t . \frac{(1 - g^{-1})}{(1 - g^{-n})} \quad ..(A4)$$

The unit cost of this infrastructure would have increased at a rate of g per annum from the datum year (i.e. to $c_i . e^t$), and the cost of infrastructure in each class taken into service in year t would therefore amount to:

$$C_i = c_i . q_i . g^t . p^t \frac{(1 - g^{-1})}{(1 - g^{-n})} \quad ..(A5)$$

The total cost of infrastructure in the year would be the sum of all expenditures on all (say, x) infrastructure classes. That is:

$$I_t = \left[\sum_{i=1}^{x} c_i . q_i\right] . (gp)^t \frac{(1 - g^{-1})}{(1 - g^{-n})} \quad ..(A6)$$

Now, the total historical cost of infrastructure in commission in year t is the sum of the capital expenditures over the past n years: i.e. $I_t(1 + (ge)^{-1} + (ge)^{-2} + \cdots + (ge)^{-(n-1)})$, the sum of which is:

$$H_t = \left[\sum_{i=1}^{x} c_i . q_i\right] . (gp)^t \frac{(1 - g^{-1})}{(1 - g^{-n})} . \frac{(1 - (ge)^{-n})}{(1 - (ge)^{-1})} \quad ..(A7)$$

Or, alternatively:

$$H_t = I_t . \frac{(1 - (gp)^{-n})}{(1 - (gp)^{-1})} \quad ..(A8)$$

A similar line of reasoning can be used to derive relationships for the costs of education and training and the amount at any time invested in the workforce.

The number of people in each occupational category participating in the workforce in year t is given by:

$$P_i = l_i . g^t \quad ..(A9)$$

The number entering as a result of growth in employment opportunities during the year (the difference between those needed this year and those needed last year) is:

$$l_i . g^t - l_i . g^{t-1} = l_i . g^t . (1 - g^{-1}) \quad ..(A10)$$

This number must be increased to replace those retiring or withdrawing from the workforce for other reasons. Given the weighted average working life of b years for a representative worker, further recruits would be necessary to maintain economic output. The numbers involved would include those that entered the workforce as a result of increased labour requirements b years ago, plus those who entered the workforce 2b years ago in response

to the same requirement, plus those who joined for growth 3b years ago etc. Therefore, provided that the labour market has been expanding, the total number of people replacing those who have left the workforce at the beginning of year t will be:

$$l_i \,.(1 - \, g^{-1}).(g^{t-b} + g^{t-2b} + g^{t-3b} \ldots.) = \frac{l_i.g^t.(1-g^{-1})}{(g^b - 1)} \quad ..(A11)$$

The total number of people in each occupational category will then be:

$$l_i.g^t.\frac{(1-g^{-1})}{(1-g^{-b})} \quad ..(A12)$$

The average unit cost of educating and training in each category, taken from the datum year, would be $a_i.p^t$, and therefore the cost of all new workforce entrants in this class would be:

$$A_i = a_i.l_i.g^t.p_t\frac{(1-g^{-1})}{(1-g^{-b})} \quad ..(A13)$$

If the number of occupational categories were y, the total cost associated with the education and training of new workforce entrants in year t would then be:

$$T_t = \left[\sum_{i=1}^{y} a_i.l_i\right].(gp)^t\frac{(1-g^{-1})}{(1-g^{-b})} \quad ..(A14)$$

The total historical cost of the workforce at that time would be the sum of all expenditures made in the past on all those who are still working in year t. That is: $T_t(1 + (gp)^{-1} + (gp)^{-2} + \cdots + (gp)^{-(b-1)})$, the sum of which can be written:

$$W_t = \left[\sum_{i=1}^{y} a_i.l_i\right].(gp)^t\frac{(1-g^{-1})}{(1-g^{-b})}.\frac{(1-(gp)^{-b})}{(1-(gp)^{-1})} \quad ..(A15)$$

Or, alternatively:

$$W_t = T_t.\frac{(1-(gp)^{-b})}{(1-(gp)^{-1})} \quad ..(A16)$$

Thus, the amounts of invested in the national infrastructure and in the national workforce are functions of both the real growth rate and the nominal growth rate of the economy.

A useful additional relation is the weighted average age of capital invested in infrastructure. This is found by summing annual expenditures over the previous n years and dividing by the total historical cost of infrastructure in service, as follows:

The sum

$$I_t.\left[1(gp)^{-1} + 2(gp)^{-2} + 3(gp)^{-3} + \cdots + (n-1)(gp)^{-(n-1)}\right] \quad ..(A17)$$

simplifies to:

$$I_t.[\frac{(-n-1)((gp)^{-n})}{(1-(gp)^{-1})} + \frac{(gp)^{-1}(1-(gp)^{-n+1})}{(1-(gp)^{-1})^2}] \quad ..(A18)$$

Dividing by I_t, and after some manipulation the average age of capital investments made in infrastructure is given by:

$$\frac{1}{(gp-1)} - \frac{n}{((gp)^n-1)} years \quad ..(A19)$$

The corresponding average age of investments made in the workforce is:

$$\frac{1}{(gp-1)} - \frac{b}{((gp)^b-1)} years \quad ..(A20)$$

A similar line of reasoning can be used to find the weighted average age of infrastructural assets and the weighted average years of experience of participants in the workforce. These are given by:

$$\frac{1}{(g-1)} - \frac{n}{(g^n-1)} years \quad ..(A21)$$

and,

$$\frac{1}{(g-1)} - \frac{b}{(g^b-1)} years \quad ..(A22)$$

respectively,

Appendix B: Analysis of the Cash Purchase policy rule

For this system, and for the other systems, the simplifying assumption is made that expenditures in any year *t + 1* are financed by tax revenues earned in year *t* and these become available only at the year end.

Since all capital expenditure is financed by taxation the only result required is the amount of tax needed to finance expenditure in year *t*.

For infrastructure, this, using equation (A8), is given by:

$$I_t.(gp) = H_t.\frac{(gp-1)}{(1-(gp)^{-n})} \quad ..(B1)$$

The tax revenues applied to the investment in the workforce are similarly described by:

$$T_t.(pe) = W_t.\frac{(gp-1)}{(1-(gp)^{-b})} \quad ..(B2)$$

APPENDIX C: Analysis of the Chinese Emperor's policy rule

Loans raised for capital expenditures are never redeemed (at least on a net basis). All outstanding debt is simply accumulated. Interest arising on this debt is paid for by issuing additional loans for the purpose.

Using equation A8, the outstanding debt for infrastructure at the end of any year t is found by taking the amount to be spent in the current year $H_t \frac{(1-(gp)^{-1})}{(1-(gp)^{-n})}$ and adding to it all amounts ever spent in the past , increased by the accumulation of capitalised interest. The result is described by the following equation:

$$H_t \frac{(1-(gp)^{-1})}{(1-(gp)^{-n})}[1+(gp)^{-1}r^1+(gp)^{-2}.r^2+(gp)^{-3}.r^3+\cdots] \quad ..(C1)$$

If $r \leq gp$ (i.e the nominal growth rate exceeds the interest rate) this converges to a stable limit:

$$\frac{H_t(gp-1)}{(1-(gp)^{-n})}.\frac{1}{(gp-r)} \quad ..(C2)$$

Otherwise, the amount of outstanding debt increases indefinitely and in due course tends to infinity (i.e. results in bankruptcy).

Similarly, the outstanding debt used to finance education and training is given by:

$$W_t \frac{(1-(gp)^{-1})}{(1-(gp)^{-b})}[1+(gp)^{-1}r^1+(gp)^{-2}.r^2+(gp)^{-3}.r^3+\cdots] \quad ..(C3)$$

And, again, this increases indefinitely unless $r \leq gp$.

Thus, if $r > gp$, as is usually the case, the government deficit in each year will steadily increase until either bankruptcy or a radical reorganisation of state finances occurs.

Note that this is currently not the case in the UK, the USA, Japan and the Eurozone. In these countries the activities of the central banks (quantitative easing) have in most cases suppressed rates of interest below the rate of increase in tax revenues. Where tax revenues have declined, as in Greece, a financial crisis has been the result.

APPENDIX D: Analysis of Queen Victoria's policy rule

Like the previously described system, outstanding loans are never redeemed. However, interest is promptly paid on all outstanding debt via appropriate charges to the taxpayer. The amount of outstanding debt is therefore equal to the sum of the current capital expenditure and previous capital expenditures ever made.

Debts associated with infrastructure are therefore:

$$H_t \frac{(1-(gp)^{-1})}{(1-(gp)^{-n})}[1+(gp)^{-1}+(gp)^{-2}+(gp)^{-3}+\cdots] \quad ..(D1)$$

Unless $gp \leq 1$ (i.e., growth in tax revenues remains positive) this converges to:

$$\frac{H_t}{(1-(gp)^{-n})} \quad ..(D2)$$

Interest charges to the taxpayer are given by:

$$\frac{H_t(r-1)}{(1-(gp)^{-n})} \quad ..(D3)$$

Debts associated with the state investment in education and training are:

$$W_t \frac{(1-(gp)^{-1})}{(1-(gp)^{-b})}[1+(gp)^{-1}+(gp)^{-2}+(gp)^{-3}+\cdots] \quad ..(D4)$$

Which under the same conditions converges to:

$$\frac{W_t}{(1-(gp)^{-b})} \quad ..(D5)$$

And interest charges to the taxpayer on these debts is given by:

$$\frac{W_t(r-1)}{(1-(gp)^{-b})} \quad ..(D6)$$

APPENDIX E: Analysis of the Depreciation Charge policy rule

In this system all interest arising on outstanding debt is charged directly to the state revenue account and therefore financed directly by taxpayers in the year in which it arises. Capital expenditures are, in principle, financed by borrowings. But, amounts in borrowings outstanding are reduced by depreciation charges for the use of assets and human capital charged, again, directly to the taxpayer.

The simplest way to account for depreciation is to apply the straight-line depreciation charge procedure. The annual charge is given by dividing the original cost of an asset by the reasonably expected useful life of the asset. For infrastructure this would be: H_t/n and for the investment in education and training it would be: W_t/b.

These amounts would be applied to the reduction of outstanding debt, or, alternatively, to a reduction in the amounts of debt raised to finance current expenditures. In this case the appropriate assumption would be that charges to the revenue account arising in the previous year would reduce the new borrowings of the current year. That is:

$$I_t - \frac{H_t}{n}.(gp)^{-1} = H_t[\frac{(1-(gp)^{-1})}{(1-(gp)^{-n})} - \frac{(gp)^{-1}}{n}] \quad ..(E1)$$

The total amount in outstanding debt would then be given by:

$$H_t\left[\frac{(1-(gp)^{-1})}{(1-(gp)^{-n})} - \frac{(gp)^{-1}}{n}\right].[1+(gp)^{-1}+(gp)^{-2}+\cdots+(gp)^{-(n-1)}]$$

which simplifies to:

$$H_t\left[1-\frac{(1-(gp)^{-n})}{n.(gp-1)}\right] \quad ..(E2)$$

Interest charges to the taxpayer in each year would be:

$$H_t\left[1-\frac{(1-(gp)^{-n})}{n.(gp-1)}\right].(r-1) \quad ..(E3)$$

Similarly, the amount of outstanding debt for education and training would be:

$$W_t\left[1-\frac{(1-(gp)^{-b})}{b.(gp-1)}\right] \quad ..(E4)$$

And the corresponding interest charge would be:

$$W_t\left[1-\frac{(1-(gp)^{-b})}{w.(gp-1)}\right].(r-1) \quad ..(E5)$$