

DYNAMIC REPAYMENT OF MORTGAGE LOANS: A SOLUTION FOR THE LOW-INCOME SECTOR?

W. R. Gevers

*University of Stellenbosch Business School
PO Box 610, Bellville, 7535*

Abstract

By using a dynamic installment repayment plan to finance a mortgage loan rather than the usual fixed installment financing, the threshold at which a prospective homeowner may enter the housing market may be lowered substantially. In this paper this method of financing will be evaluated to determine under which circumstances it could be used to help the low-income group to obtain housing, and also to highlight some of its deficiencies. Historic trends of income are also analysed to determine the income growth potential of the low-income sector. The income growth potential does not seem to distract from the potential of the dynamic repayment of mortgage loans.

1. INTRODUCTION

To discuss the financing of housing for the individual homeowner in an Operations Research environment may be frowned upon, but if research regarding the use of Operations Research in business is examined, one finds that concepts regarding the time value of money, such as net present value, are listed as possible operations research techniques both in South Africa (Wegner, 1983: 120-124) and abroad (Schumacher & Smith, 1965: 1023-1027).

The individual homeowner often finances his home by putting down a deposit of say 20 percent of the purchase price and the remaining 80 percent by means of a mortgage bond which is repaid in fixed monthly installments (provided the interest rate remains constant) over a fixed length of time, say 20 years. Although 100 percent mortgage financing is provided by a number of financial institutions, this is normally only available to professional people or those who can supply some other form of security. Financial institutions who provide money for mortgage financing traditionally do not allow the borrower to spend more than 25 percent (30 percent is sometimes considered) of his gross household income on his installments. For the prospective home buyer this creates a twofold problem. In the first place he battles to save enough to put down as a deposit, often finding that by the time he has saved what

originally seemed to be enough, the selling prices, and hence the deposit, has increased, making his savings insufficient for a deposit. Furthermore he must then finance a larger bond requiring a larger installment which may exceed 25 percent of his current household income. Yet a year or two hence his income will have grown, due to wage or salary adjustments to counter the effect of inflation or due to advancement, to such an extent that he can afford the dwelling that was originally envisaged.

It is doubtful whether there are any strong arguments against the use of some method of limiting the amount spent by a person on housing as many financial institutions do. One can argue about whether the breadwinner's income only, or the total household income should be used in determining the cut off point, or whether net or gross income should be used, and what percentage to use, but that is of no concern in this paper. Whatever cut off percentage is used, it should be determined in such a way that one should be able to maintain that percentage for the total duration of the repayment of the bond. Although this is probably the principle used by financial institutions in determining the maximum affordable bond repayment, it is only applied on the borrower's current income to determine a fixed installment. Thus potential growth in income is ignored in determining the installment.

If one were to allow the bond repayment installment to grow over time, one would come closer to maintaining a fixed percentage of income to be spent on housing. A growing bond repayment installment has the advantage that for a particular amount borrowed and repaid over a fixed period, the initial installment is lower than the equivalent fixed installment, thus reducing the required income level when purchasing a home. Although later installments will become higher than the fixed installment, income should have grown to such an extent to still make the housing affordable.

Although the principle of dynamic repayment of a mortgage loan is not new (Jorgenson, 1977), it is important to investigate under what conditions this method of financing housing is viable, or perhaps even a better alternative to the fixed repayment schedule.

The results of this investigation are of a general nature and could be applied to any prospective home buyer. It is, however, of particular importance to the low-income sector where adequate housing cannot be obtained by merely lowering the prospective home buyer's requirements, but the basic need is to finance some form of shelter.

As the emphasis is on investigating a method of home financing for the low-income sector of the population, it is also important to determine whether and to what extent this sector's income has increased over the last number of years. This should indicate whether a dynamic repayment schedule could be affordable.

2. DELIMITATIONS

If the dynamic installment or progressive annuity method of financing is considered as an alternative to the fixed installment method of financing a home, a number of parameters must be investigated in depth. The term over which the bond is repaid and the governing interest rate are factors which are common to both methods of financing, but the growth rate of the installment, and the period over which the installment is allowed to grow are factors specific to the dynamic installment method. When compared to the fixed annuity, the progressive annuity has lower initial installments, but higher later installments.

The extent of the initial reduction and the final increase need to be evaluated. Furthermore, since the initial installments are lower than the fixed annuity installment for the same size loan, initial installments may not be large enough to cover the interest on the loan and outstanding interest must be capitalised into the loan. The extent to which a loan may grow needs to be investigated.

The above mentioned factors pertaining to the method of progressive annuity financing are analysed and discussed in this paper. No attempt is made to address the problems of providing homes to many low-income inhabitants of South Africa and how these homes could be financed. The results of this paper should set some guidelines as to when dynamic installments are viable as a method of financing a mortgage bond.

The income growth potential of a number of categories of people are estimated by evaluating past income patterns over time. This will give an indication of the extent to which incomes have kept pace with inflation over the last number of years. If incomes keep pace with inflation, a dynamic installment plan of mortgage financing should be affordable.

The paper also does not evaluate the increase or decrease in the value of the property acquired as a security to the lender, nor the effect that this type of financing may have on the operations of the lender.

3. THE DATA AND ITS TREATMENT

3.1 *The data*

The data for the evaluation of the dynamic installment payback model was generated by a model developed for this purpose and discussed in section 3.2. Income data was retrieved from the Standard Bank's Corporate Access Terminal System (CATS) as well as from the salary surveys conducted by FSA-Contact (Pty) Ltd who publish the Peromnes income surveys biannually. The Consumer Price Index was retrieved from statistics published by the Department of Statistics and CATS.

3.2 *The model*

The calculation of the periodic payment for a fixed installment type of loan is a simple procedure which has been programmed on most business calculators. The calculation of the initial payment for the repayment of a loan using the progressive annuity method can, however, not be accomplished using a single formula. The net present value of the periodic payments (which are not constant) at the interest rate quoted, is equal to the amount borrowed (that is the loan). Since it is not possible to convert a net present value to a string of variable cash flows, it is necessary to start with an arbitrary initial installment and calculate the subsequent installments using the installment growth rate. The loan amount (i.e. the amount that will actually be borrowed) is then divided by the net present value of this string of cash flows to give a factor. The assumed initial and all following installment are subsequently multiplied by the factor, yielding the correct installment plan.

The above process was simulated using the LOTUS 1-2-3 spreadsheet package. The model is documented in Appendix A. Provision was made for five input parameters, namely the size of the loan, the term of repayment of the loan, the interest rate, the installment growth rate and the period during which the installment may grow. With the use of a macro it was possible to automate the calculations.

A further macro was developed to automatically evaluate a whole range of input parameters.

The model was developed to calculate an annual installment rather than a monthly installment. Although monthly compounding of interest is more accurate, the errors involved in compounding annually are small. The principles involved in dynamic installment financing are clearly illustrated, whether one uses annual or monthly compounding. In the same vein an arbitrary loan amount of R1 000 is used to illustrate the principles, and no attempt has been made to determine the size of an actual home loan.

4. RESULTS

4.1 *Effect of progressive annuity bond repayments*

Figure 1 shows the outstanding balance of a loan of R1 000 repaid over 20 years at interest rate of 14% and 20% for a fixed installment and an installment that grows by 10% per year for the full term of the loan. When the interest rate is 14%, the initial installment is reduced by 48,1% (from R150,99 to R78,36), but the final installment is increased by 217,4% to R479,21. At the current high level of interest of 20%, the initial installment is decreased by 40,9%, while the final installment is increased by 261,2%. At 14% interest the loan grows to a maximum amount outstanding of R1 536,46 11 years after repayment of the loan is commenced (R1 909,90 after 13 years at 20% interest).

The reduction in initial installment is at least 40% even with high interest rates, and this could have a significant influence in making housing more affordable. The final installment, however, is more than 200% more than the fixed installment for the same size loan. This gives rise to concern over whether the borrower's income will have grown to the same extent as the installment has to keep the housing affordable. If one were to be conservative, and to keep the housing affordable it seems as if one should not consider installments that grow for the full term of the bond.

If the R1 000 loan represented a 90% bond, the purchase price would have been R1 111. If this value is allowed to grow at an arbitrarily chosen 1% per year, the lender would be at risk from the second year to the 15th year of the bond when the interest rate is at the lower level. Without security this would be too high a risk for any institution to bear. Thus in considering alternative circumstances under which progressive annuity type of installments could be feasible, the risk to the lender must be taken into account. This risk is clearly a function of the value of the property - the faster the property increases in value, the lower the risk. Since very little is known about the resale value of low-income housing, it is best to be conservative and allow for low rates of increase in value.

In figures 2 and 3 the same conditions as above are considered, except that the installment is only allowed to grow for 10 years. Various installment growth rates are shown. The maximum amount outstanding is reduced, and it occurs earlier when the growth rate is lower. Yet high installment growth rates still yield sizable maximum amounts outstanding.

Longer periods of installment growth also yield maximum outstanding amounts which are large compared to the size of the initial loan if the installment growth rate is kept fixed as shown in figures 4 and 5 where this rate was fixed at 6%. If one wants the loan to reduce to its original size after approximately 10 years, then the installment should not be allowed to grow for longer than 10 years.

4.2 Term of loan

It is known from fixed annuity bond repayments that a longer term of repayment generally leads to a lower installment, but that the reduction in installment with longer repayment periods is small when the interest rates are high. In order to evaluate this effect on dynamic installments, a repayment plan in which the installments grow by 6% annually for the first 10 years was analysed for loan terms of 15 to 30 years and interest rates of 10% to 20%. The initial and final installments are expressed as a percentage of the 20 year term installment in tables 1 and 2 respectively.

Table 1 : Initial installment relative to 20 year term installment for a growth rate of 6% for 10 years

Term	Interest rate					
	10%	12%	14%	16%	18%	20%
15	116%	113%	111%	109%	107%	106%
20	100%	100%	100%	100%	100%	100%
25	92%	94%	95%	96%	97%	98%
30	88%	91%	93%	95%	96%	97%

Table 2 : Final installment relative to 20 year term installment for a growth rate of 6% for 10 years

Term	Interest rate					
	10%	12%	14%	16%	18%	20%
15	112%	110%	108%	106%	105%	104%
20	100%	100%	100%	100%	100%	100%
25	94%	95%	96%	97%	98%	98%
30	90%	93%	95%	96%	97%	98%

From the tables it is clear that with interest rates as low as 12% per year and lower, installments may be reduced by 10% if the term of the loan is extended from 20 years to 30 years. At higher interest rates the reduction in installment with a longer term is much less and is probably not warranted if one considers the disadvantage of the longer commitment.

Current interest rates are generally in the order of 20% per year and if real interest rates are here to stay, it is unlikely that interest rates will drop much lower than 14% (unless inflation is curbed). Under those circumstances there is little advantage in extending the term of the loan beyond 20 years and all further discussion is based on loans repayable over that period.

4.3 Initial and final installments

Figures 6 and 7 show the initial and final installments plotted against the installment growth rate for a number of different periods of installment growth. The loan amount is R1 000 to be repaid over 20 years

at 20% interest rate.

From figure 6 it can be seen that a substantial decrease in initial installment may be effected by a growth period of only 5 years. With a 6% growth rate for 5 years the initial installment is reduced by 16% while the maximum outstanding balance is only 7,7% more than the initial loan. The installment is reduced by 30% if the growth rate is 12% for 5 years and in this instance the maximum amount outstanding is 18,4% more than the amount borrowed.

If the period of installment growth is increased to 10 years, the initial installment is reduced by 22% with a 6% installment growth rate while the maximum amount outstanding on this loan is 22,6% higher than the initial loan. The comparative figures at the lower interest rate of 14% are a reduction of 26% with a maximum outstanding amount increased by a mere 11,4%. This does illustrate that the dynamic repayment method's advantages are somewhat curtailed by higher levels of interest.

When the installment growth is increased to 10% for 10 years the outstanding balance on the loan increases to 145,7% (126,4% at 14% interest) of the initial loan, which seems excessive. The risk to the lender becomes a factor that needs to be considered. Installment growth rates higher than 6% when the interest rate is 20% and 10% when the interest rate is 14% over a period of 10 years thus do not seem viable.

The relatively close spacing of the lines depicting longer periods of installment growth in Figure 6 clearly indicates that there is little to be gained by extending the period of growth beyond 10 years. The detrimental effect on the final installment for longer growth periods is also emphasised by the divergence of the relevant lines in Figure 7.

The final installment that the borrower could afford depends entirely on the income growth potential of the borrower. In order to be conservative one should limit the installment growth rate to a fairly low percentage, and at the same time ensure that the final installment does not become too large. If a final installment of 50% more than the fixed annuity installment is considered to be affordable, then the final installment should not exceed approximately R308. If the installment is allowed to grow for 15 years, then the growth rate should not exceed 4% to ensure that this value is not exceeded. For a 10 year growth period a growth rate of approximately 7,5% could be used, while with a 5 year growth period, a growth rate of more than 16% could be used. Such a high growth rate seems to be more than the income growth rate of the borrower (illustrated in 4.5 below) and is likely to make the housing unaffordable after a few years. Yet higher installment growth levels maintained for a shorter period effect a larger reduction in initial installment, yielding the better benefit to the potential homeowner.

It is thus clear that a substantial reduction in initial installment can be effected without causing the final installment to become too large and at the same time limiting the size of the loan to fair proportions. An ideal mix between growth rate and period of growth should thus be strived for, with the emphasis on the installment growth rate.

4.4 Risk to lender

In Figure 8 the maximum amount owing on the loan is plotted against the number of years of growth

of the installment for a number of different installment growth rates. As before, the amount borrowed amounts to R1 000 repaid over 20 years at an interest rate of 20%. The graph also shows the year in which the maximum amount owing occurs.

From this graph too it is clear that installment growth rates exceeding 6% for periods of 10 years and longer yield large outstanding amounts occurring long after repayments commence. Even with a fair growth in property value, these large outstanding amounts would probably be unacceptable to the lender. High growth rates for shorter periods or lower growth rates for longer periods have maximum amounts owing at acceptable levels.

If the lender wants to limit his risk, then the maximum amount owing on the loan should not exceed the value of the property, assuming no growth in the value of the property. If it is assumed that the R1 000 loan represents a 90% bond, then the value of the property is equal to R1 111. Figure 9 shows the installment growth rate plotted against the interest rate for various periods of installment growth and loans that have a maximum outstanding balance equal to R1 111. From the graph it is clear that even with the current high interest rate a fair installment growth rate can be maintained for a short period such as 5 years. If the lender wants to limit his risk in the above manner and the installment grows for 10 years at the current interest rate of 20%, the installment growth rate is limited to somewhat less than 4%. Under these circumstances the initial installment is 15% lower than the comparable fixed installment. A shorter growth period results in a higher installment growth rate for the same interest rate. This usually leads to a larger reduction in initial installment and a smaller final installment and is thus to be recommended.

4.5 Income growth patterns

In order to evaluate the longer term trend in income, the *per capita* average monthly earnings figures for three arbitrarily chosen industries and for the three listed population groups was extracted from the time series on CATS. The consumer price index: all items for both the low-income group and all income groups was extracted from the same source. The geometric mean annual increase in earnings and that of the CPI (all income groups) over periods of 10 and 13 years (15 years for the retail trade) are shown in Table 3.

Table 3 : Annual increase in *per capita* average monthly earnings

Start	Year End	Year Industry	All	Population group		CPI
				Whites	Blacks	
1973	1988	Retail trade	13,4%	13,2%	14,9%	13,6%
1975	1988	Manufacturing	15,7%	14,3%	17,6%	13,7%
1975	1988	Construction	13,6%	14,3%	13,3%	13,7%
1978	1988	Retail trade	14,7%	14,7%	16,3%	14,5%
1978	1988	Manufacturing	16,3%	15,1%	18,1%	14,5%
1978	1988	Construction	14,2%	12,3%	10,9%	14,5%

From the table it is clear that in general for all population groups the increase in earnings has kept pace with inflation as measured by the CPI. There is little difference between the population groups, although the black population seem to have received slightly higher increases. The construction industry has fared worst, with the mean annual increase over 10 years trailing the CPI by a number of percentage points. Nevertheless a 10% per year increase has been maintained for 10 years and longer.

The above comparison was made relative to the all income group CPI and not relative to the low-income group CPI. It was found that these two indices are almost identical, with the low-income group CPI currently at a lower level than the all income group CPI. This is clearly illustrated in Figure 10 which shows the difference between the two indices over time.

The figures reported in Table 3 contain a large amount of aggregation which makes it impossible to distinguish between the low-income group and others. In order to make this distinction, the median basic monthly remuneration for all incumbents in the salary grades 19 and 15 of the biannual Peromnes salary survey were extracted and analysed. Salary grade 19 is the lowest grade, while salary grade 15 represents the lowest grade in which white workers fall. The basic income is analysed since it is the best representation of cash received. The total income, which includes fringe benefits, actually displayed a higher rate of increase than the basic income.

Figure 11 depicts the cumulative six-monthly increase in income for both salary groups and the CPI. From the figure it can be seen that the increase in income of the lowest income group over the last six years has outperformed the CPI. In fact it is clear that the low-income group's income seems to keep up with inflation. Although Ashburner (1986: 8) in analysing income over the period July 1981 to July 1986 did not find that incomes kept pace with the CPI, it must be emphasized that she did not focus specifically on the low-income group. Nevertheless it was found that black incomes increased by 92% of the CPI.

It thus seems safe to assume that when inflation as measured by the CPI is increasing at more than 10% per year, the low-income group will experience an increase in income of up to 10% per year. This seems to make the dynamic repayment of a mortgage loan affordable.

5. CONCLUSIONS AND RECOMMENDATIONS

A model was developed to evaluate the usefulness of the dynamic installment method of loan repayment for prospective homeowners. From the analysis it is clear that a substantial reduction in initial installment may be effected without placing too large a burden on the homeowner at a later stage, and at the same time keeping the lender's risk at an acceptable low level. At the current high interest rate of 20% the initial installment may be reduced by 21% by letting the installment grow for 5 years at a rate of 8% without the loan exceeding the value of the property (90% bond). At a lower 14% interest rate, a 34% reduction in initial installment may be effected by letting the installment grow by 12,7% for 5 years, again without the loan exceeding the value of the property.

In order to limit the risk to the lender, installments should not be allowed to grow for more than 10 years, with 5 years of installment growth being preferable. A shorter period of growth at a higher growth rate has a more beneficial effect on the initial installment than a longer period of growth at a lower growth

rate.

There is little benefit in extending the term of the loan to periods exceeding 20 years if the interest rate is 14% or higher.

An analysis of income patterns over the past number of years indicates that income levels of the low-income group seem to keep up with the increase in the CPI, or at most trail the CPI by at most a percentage point. This appears to indicate that the dynamic repayment method should be affordable.

Although, based on this analysis, the dynamic repayment of mortgage loans seems like a feasible method of financing a home, a number of aspects still require further investigation. Some of these are the following.

Since the initial installments using a dynamic repayment plan do not cover the full interest charge, the financier who provided the mortgage money may not be earning a sufficient income on the money provided. This possible detrimental effect on the profitability of the financier, albeit only during the initial growth phase of the repayment schedule, needs to be investigated further.

The lender may also seek some form of surety against a possible default by the homeowner when interest is being accumulated into his loan account. Under the current moratorium scheme announced by the Government to help homeowners cope with the high interest rates (*Finansies & Tegniek*, 1989: 18), the Government itself provides the surety. Who should provide the surety if the dynamic repayment of mortgage loans became common practice, is an open question. Perhaps private enterprise through the homeowners' employers should bear this risk.

The extent to which the value of the property which is acquired by the low-income group, increases or decreases, is an unknown factor. For the analysis contained in this paper it was assumed that there was no movement in value over time. It is more likely that as the CPI increases, building costs will also increase. As a result the value of used housing is also likely to increase. The order of this movement needs to be investigated further for an evaluation of the risk involved in this method of mortgage repayment.

Acknowledgment

The author is indebted to FSA Contact (Pty) Ltd who provided the Peromnes data, and to Mr DJ Joubert who suggested the analysis which is contained in this paper.

REFERENCES

- Ashburner, J. 1986. Salary and wage trends over the past year. *IPM Journal*. October, 8-10.
- Finansies & Tegniek*. 1989. Verligting vir huiseienaars: gesond of nie? 42(23), 9 June, 18.
- Jorgenson, N.O. 1977. *Housing finance for the low-income groups*. Rotterdam : Bouwcentrum.
- Schumacher, C.D. & Smith B.E. 1965. A sample survey of industrial operations research activities II. *Operations Research*. 13, 1023-1027.
- Wegner, T.A. 1983. A survey of quantitative methods in South African management. *South African Journal of Business Management*. 14(3), 120-124.

Figure 1 : Outstanding loan and value vs time R1000 over 20 years, 10% growth

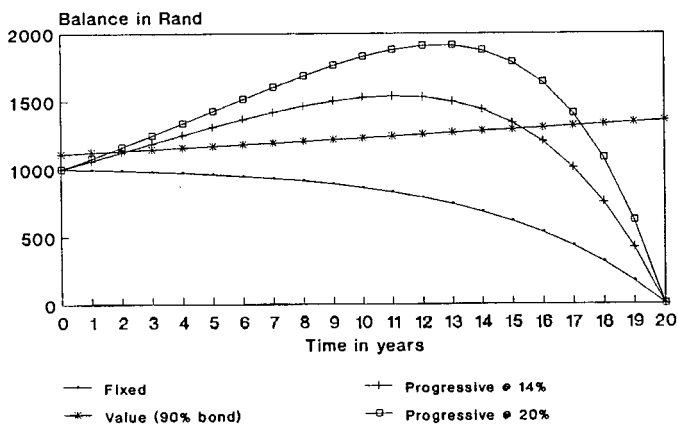


Figure 2 : Outstanding balance of loan vs time R1000 for 20 years @14%, 10 year growth

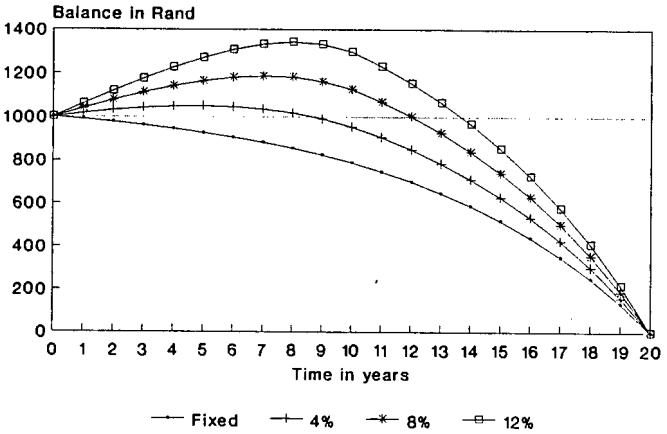


Figure 3 : Outstanding balance of loan vs time R1000 for 20 years @20%, 10 year growth

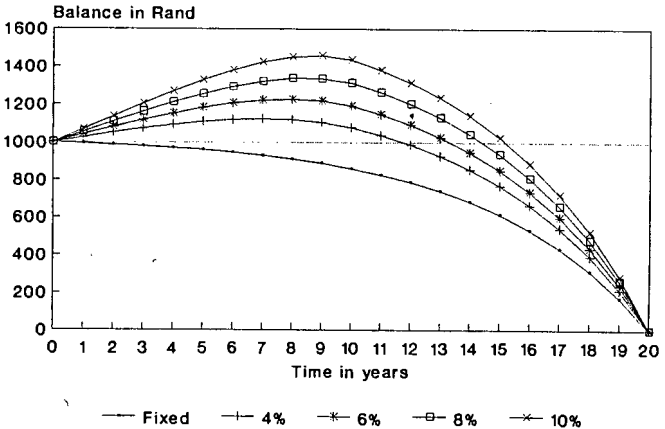


Figure 4: Outstanding balance of loan vs time R1000 for 20 years @14%, growth rate 6%

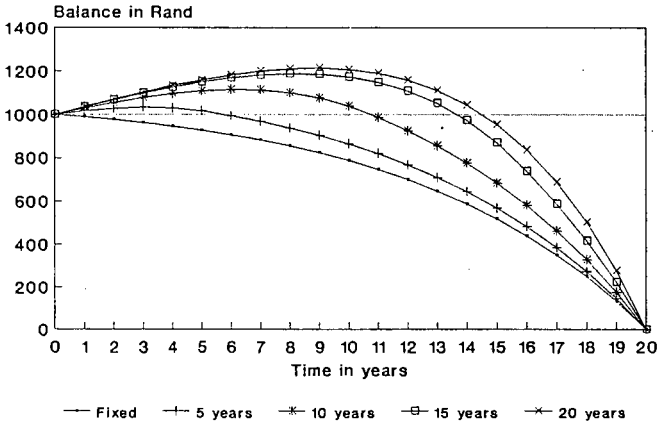


Figure 5: Outstanding balance of loan vs time R1000 for 20 years @20%, growth rate 6%

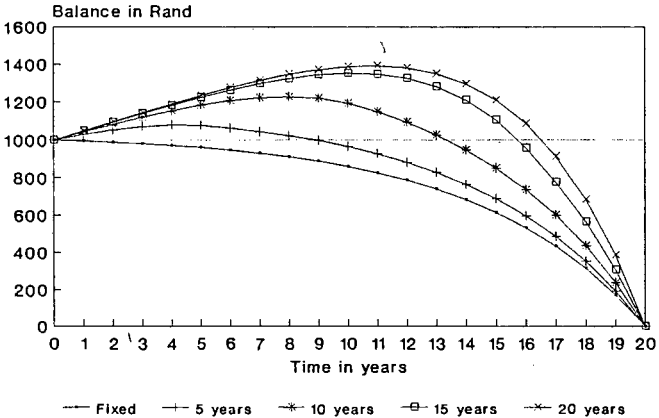


Figure 6 : Initial installment vs growth rate
R1000 @ 20% for 20 years

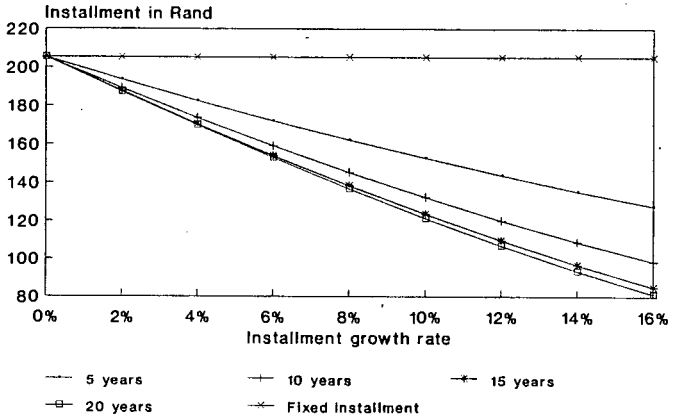


Figure 7 : Final installment vs growth rate
R1000 @ 20% for 20 years

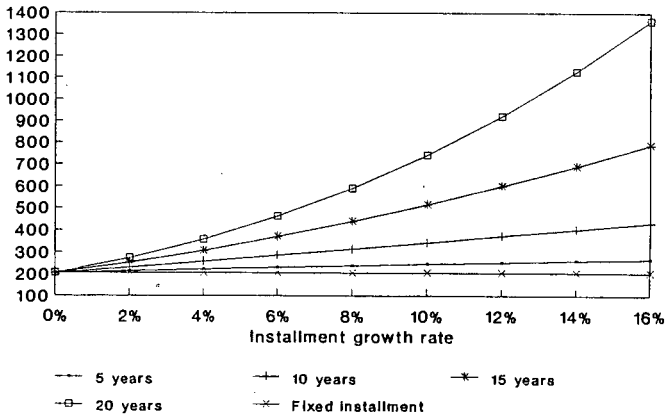


Figure 8 : Maximum amount owing R1000 @ 20% for 20 years

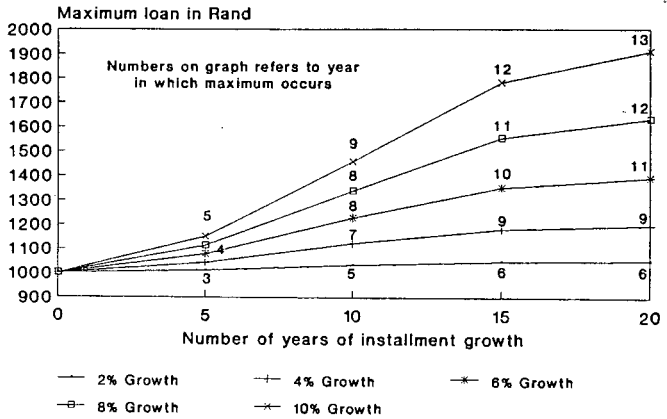


Figure 9 : Installment growth rate vs interest rate 20 year term; maximum amount owing R1111 (R1111 value yields R1000 loan 90% bond)

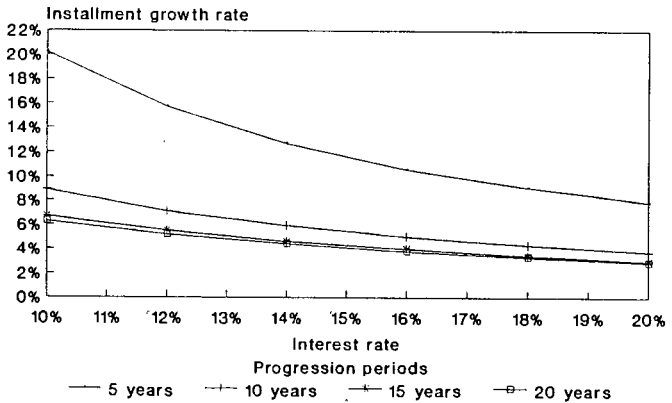


Figure 10 : Monthly difference between Low-income CPI and CPI vs Time

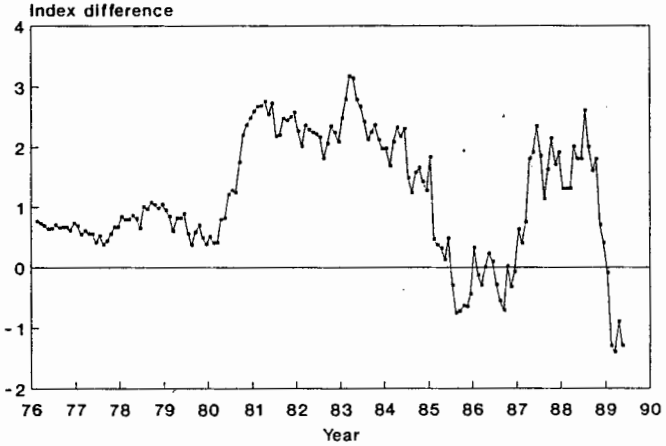
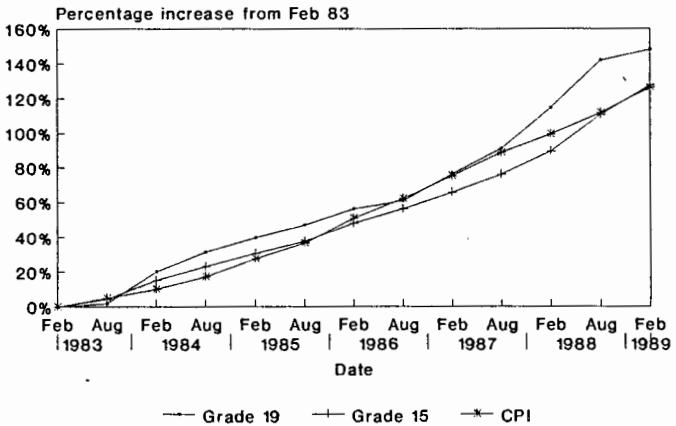


Figure 11 : Cumulative increase in Basic income, CPI accumulated 6-monthly, base month: Feb 83



APPENDIX A

DYNAMIC REPAYMENT OF LOANS MODEL

Layout of the spreadsheet

	A	B	C	D	E	F	G	H	
1	Progressive annuity model						Property growth ra		1,0%
2						Size of loan		90,0%	
3						Fixed installment		205,36	
4	Years of growth			5		Initial instal.		152,58	
5	Installment growth rate			10,0%		Final instal.		245,74	
6	Term of bond			20		Maximum owing		1148,93	
7	Annual interest rate			20,0%		Year of max owing		5	
8	Amount borrowed			1000,00					
9									
10	Period	Open Bal	Interest	Instal.	Cap Redem	End Bal	Cum Int	Cum Redem	
11	0					1000,00			
12	1	1000,00	200,00	152,58	-47,42	1047,42	200,00	-47,42	
13	2	1047,42	209,48	167,84	-41,64	1089,06	409,48	-89,06	
14	3	1089,06	217,81	184,63	-33,19	1122,25	627,30	-122,25	
15	4	1122,25	224,45	203,09	-21,36	1143,61	851,74	-143,61	
16	5	1143,61	228,72	223,40	-5,33	1148,93	1080,47	-148,93	
17	6	1148,93	229,79	245,74	15,95	1132,98	1310,25	-132,98	
18	7	1132,98	226,60	245,74	19,14	1113,84	1536,85	-113,84	
19	8	1113,84	222,77	245,74	22,97	1090,88	1759,62	-90,88	
20	9	1090,88	218,18	245,74	27,56	1063,32	1977,79	-63,32	
21	10	1063,32	212,66	245,74	33,07	1030,24	2190,46	-30,24	
22	11	1030,24	206,05	245,74	39,69	990,55	2396,50	9,45	
23	12	990,55	198,11	245,74	47,63	942,93	2594,62	57,07	
24	13	942,93	188,59	245,74	57,15	885,78	2783,20	114,22	
25	14	885,78	177,16	245,74	68,58	817,20	2960,36	182,80	
26	15	817,20	163,44	245,74	82,30	734,90	3123,80	265,10	
27	16	734,90	146,98	245,74	98,76	636,15	3270,78	363,85	
28	17	636,15	127,23	245,74	118,51	517,64	3398,01	482,36	
29	18	517,64	103,53	245,74	142,21	375,43	3501,53	624,57	
30	19	375,43	75,09	245,74	170,65	204,78	3576,62	795,22	
31	20	204,78	40,96	245,74	204,78	0,00	3617,58	1000,00	
32									
33									
34									
48									
49									
50				245,74		1148,93			

Formulas in the cells

Cell address:	[Range Name]	Formula
D4:	[JARE]	5
D6	[TERMYN]	20
H3:		@PMT(D8,D7,D6)
H4:		+ AANV
H5:		@MAX(D12..D49)
H6:		@MAX(F12..F49)
H7:		@MAX(I12..I49)
D8:	[LENING]	@NPV(D7,D12..D31)
E8:		1000/LENING
F8:	[FAKTOR]	1.5258282407
C12:		+ B12*\$D\$7
D12:	[AANV]	100*FAKTOR
E12:		+ AANV-C12
F12:		+ B12-E12
G12:		+ C12
H12:		+ E12
I12:		@IF(F12 = \$H\$6,A12,0)
B13:		+ F12
C13:		+ B13*\$D\$7
D13:		+ AANV*(1 + \$D\$5)
E13:	[BULK]	+ D13-C13
F13:		+ B13-BULK
G13:		+ G12 + C13
H13:		+ H12 + BULK
I13:		@IF(F13 = \$H\$6,A13,0)
A14:	[PER]	3
B14:		+ F13
C14:		+ B14*\$D\$7
D14:		+ D13*(1 + \$D\$5)
E14:		+ D14-C14
F14:		+ B14-E14
G14:		+ G13 + C14
H14:		+ H13 + E14
I14:		@IF(F14 = \$H\$6,PER,0)

Formulas in A14 to I14 are repeated in all subsequent rows to make up the full term

Macro to calculate dynamic repayment schedule

```

{windowsoff}{indicate BUSY}{paneloff}
{goto}PER~/RE.{end}{down}{end}{right}~
/DF{esc}~{down}TERMYN+2}~1~~~
{goto}AANV~100~{down}{left 2}
/C{right 2}~.{down}JARE}~
{right 2}{end}{down}+{up}~{left 2}
/C{right 2}~.{left}{end}{down}{right}~
{goto}BULK~/C{end}{right}~.{left}{end}{down}{right}{right}~
{goto}LENING~/NPV((up){down 4}~{down}TERMYN-1)}~
{right}/RV~{right}~{goto}AANV~100*FAKTOR~
{goto}PER~/end}{down}{up 2}/RE.{down 2}{end}{right}~
{home}{panelon}{indicate}{windowson}

```

- Clear previous analysis
- Create column for number of periods
- Make initial installment 100
- Copy installment for years of growth
- Create formula for remaining fixed installment
- Copy installment for remainder of term
- Copy formulae for other calculations
- Calculate NPV of installments
- Calculate multiplication factor for R1000 loan
- Erase superfluous lines