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South Africa's Unemployment Insurance Fund Benefit Function: A Mathematical Critique

Aidan J. Horn

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This paper highlights the unnecessary complexity of South Africa's Unemployment Insurance Fund (UIF) benefit function, known as the Income Replacement Rate (IRR), and the disadvantageous manner in which the IRR is low for most earners. Possible alternative formulae are described, along with the implications for total expenditure on the UIF. The paper recommends simpler (and more optimal) formulae.

1 Acronyms and symbols used in this paper

f	the linear IRR function between $(0, URR)$ and (Y_{LRR}, LRR)
g	$:= 0.38$
h	the existing (codified) function given from the UIF Act
IRR	Income Replacement Rate
k	IRR function that is tangential to the flat rate benefit hyperbola q
LMDSA	Labour Market Dynamics in South Africa
LRR	Lower Income Replacement Rate
PALMS	Post-Apartheid Labour Market Series
q	the effective IRR given by a flat rate benefit above Y_{LRR}
QLFS	Quarterly Labour Force Survey
SALDRU	Southern Africa Labour and Development Research Unit
StatsSA	Statistics South Africa
UIF	Unemployment Insurance Fund
URR	Upper Income Replacement Rate
Y_i	the contributor's monthly rate of income
Y_{LRR}	the benefit transition income level.

2 Introduction

South Africa's *Unemployment Insurance Act, No. 63 of 2001* (2002) provides for five categories of benefits, not including the new covid-19-induced Temporary Employee/Employer Relief Scheme (TERS). Those are: the usual unemployment benefits, illness benefits, maternity benefits, adoption benefits, and dependant's (upon death) benefits. Amendments to the Act in Section 12(1) have added paternity benefits and reduced working time benefits. A contributor's entitlement to unemployment, reduced working time, illness and dependant's benefits "accrues at a rate of one day's benefit for every completed four days of employment," up to a maximum of 365 days benefit in the four year period preceding a dismissal (*Unemployment Insurance Act, No. 63 of 2001*, 2002: s13(3)*(a)*). Section 12(3)*(b)* in the Act allows for a sliding scale of unemployment benefits, as a proportion of one's salary. After 238 days of benefits have been paid, the remainder of the credits are paid at a flat rate of 20% of one's original salary (s12(3)*(d)*). However, maternity and paternity benefits are always paid at flat rates of 66% (s12(3)*(c)*). In addition, in accordance with the 1953 International Labour Organisation Convention (Convention No. 102), UIF benefits are capped when the wage reaches the 'benefit transition income level', commensurate with the earnings level of a "skilled manual labourer". With respect to the illness, maternity, adoption and paternity benefits, the unemployment insurance benefit is a maximum, subject to the restriction that the sum of the unemployment insurance benefit and any payments received from the employer should not exceed the contributor's normal rate of remuneration.

Schedule 2 in the Act lays out a formula for calculating the sliding scale benefit to which an Unemployment Insurance Fund (UIF) contributor is entitled. UIF benefits are calculated as a proportion of one's salary. However, the proportion of one's salary that is awarded as a benefit (called the income replacement rate (IRR)) slides from 60% (the 'upper IRR') at zero wages, to 38% (the 'lower IRR') at a predetermined 'benefit transition income level'. In practice, the current IRR formula declines so rapidly that workers earning above the minimum wage receive a benefit no more than 50% of their original wage. The Minister of Labour may choose the upper and lower income replacement rates (URR and LRR respectively), and the benefit transition income level. The URR and LRR do not change often, rather, the benefit transition income level is adjusted with rises in inflation or other nominal labour market trends. As of the time of writing, the benefit transition income level is R17 712 per month, so for the remainder of this paper, we will use that level for simplicity. For wages higher than R17 712 per month, the UIF sliding scale benefit remains capped at $38\% \times 17712 = \text{R}6730.56$.

UIF-contributors contribute 1% of their gross salary, and their employer adds on an additional 1%. However, contributions are also capped, with earners earning above the contribution threshold contributing $1 + 1 = 2\%$ of the contribution threshold.

This paper describes the sliding scale IRR formula and argues that it is unnecessarily complex. Alternatives that would improve its distributional impact are discussed, and a simulation model to quantify the revenue and expenditure effects of alternative benefit scales and contribution rates is introduced.

3 The existing IRR function

Since the income replacement rate slides from an upper limit to a lower one (depending on the income level), a question arises as to what the function is that defines the IRR between those two points. If one follows the outline in Schedule 2 (*Mathematical Calculation of Contributor's Entitlement*) of the Unemployment Insurance Act, No. 63 of 2001, the function is defined as

$$IRR = LRR + (URR - LRR) \cdot \frac{\frac{1}{2+\frac{Y_i(7-2)}{Y_{LRR}}} - \frac{1}{7}}{\frac{1}{2} - \frac{1}{7}} \tag{1}$$

$$= LRR + \frac{URR - LRR}{\left(2+\frac{5Y_i}{Y_{LRR}}\right)\left(\frac{1}{2}-\frac{1}{7}\right)} - \frac{URR - LRR}{\frac{7}{2}-1} \tag{2}$$

for incomes between zero and Y_{LRR}, where

IRR = Income Replacement Rate
LRR = Lower Income Replacement Rate
URR = Upper Income Replacement Rate
Y_i = the contributor's monthly rate of income
Y_{LRR} = the benefit transition income level.

This formula is difficult to interpret, and it is not simple. The "2" and "7" are numbers also chosen in the Act. What is the intuition behind this function? The intuition is the following. Firstly, the URR and LRR are determined by the Minister, so some function needs to be derived that intersects those two points (i.e. $(0, URR)$ and (Y_{LRR}, LRR), where the x-axis represents income and the y-axis represents the income replacement rate (IRR)). The Schedule 2 in the Act uses a hyperbola. A hyperbola with an asymptote on the $x = 0$ axis would result in an infinitely large IRR as one progresses to lower income earners from the right. Thus, the vertical asymptote needs to be negative. The hyperbola is defined such that it has a vertical asymptote of

$$x = -\frac{2}{5} \cdot Y_{LRR} \tag{3}$$

and a horizontal asymptote of

$$y = LRR - \frac{URR - LRR}{7/2 - 1}. \tag{4}$$

To see these functions more clearly, let us evaluate them at the current values for the components:

$$IRR = 0.38 + \frac{0.6 - 0.38}{\left(2 + \frac{5Y_i}{17712}\right)\left(\frac{1}{2} - \frac{1}{7}\right)} - \frac{0.6 - 0.38}{\frac{7}{2} - 1} \tag{5}$$

$$= 0.292 + \frac{0.616}{2 + \frac{Y_i}{3542.4}} \tag{6}$$

with a vertical asymptote of

$$x = -7084.8 \tag{7}$$

and a horizontal asymptote of

$$y = 0.292. \tag{8}$$

One possible immediate improvement (in order to simplify the formula) is to set the horizontal asymptote to zero:

$$IRR = (URR - LRR) \cdot \frac{\frac{1}{2 + \frac{Y_i(7-2)}{Y_{LRR}}}}{\frac{1}{2} - \frac{1}{7}} \tag{9}$$

$$= \frac{URR - LRR}{\left(2 + \frac{5Y_i}{Y_{LRR}}\right)\left(\frac{1}{2} - \frac{1}{7}\right)} \tag{10}$$

However, that would come with an added restriction that $URR = \frac{7}{2}LRR$, which is not simple. In cases where there is a restriction on the relationship between URR and LRR, one would assume that LRR should remain at 38%, since a high proportion of the UIF benefits (those above the benefit transition income level) will be dependent on that number. On the other hand, an upper income replacement rate of $\frac{7}{2} \times 38\% = 133\%$ would result in only those who earn less than R2 338 per month receiving between 100% and 133% of their salary in UIF benefits, which is excusable from the perspective of supporting the poor. But, an IRR above 100% would be incentive incompatible (and inconsistent with the law), so we don't explore this function further.

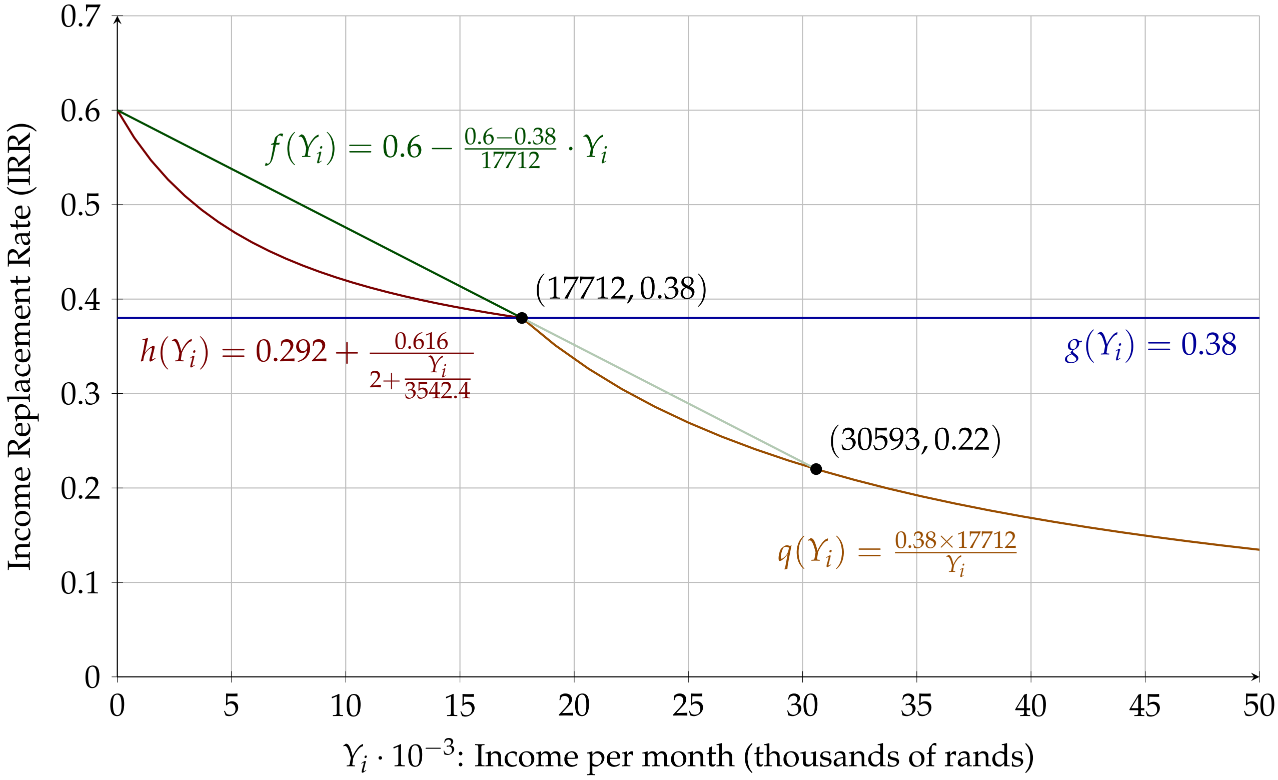
4 A linear IRR function

Let us now turn to a more obvious fix: that of a linear function. A function of

$$IRR = URR - \frac{URR - LRR}{Y_{LRR}} \cdot Y_i \tag{11}$$

is much more understandable and simpler to communicate to the general public, compared to equation (1). To compare this to the existing formula, observe Figure 1. In Figure 1,

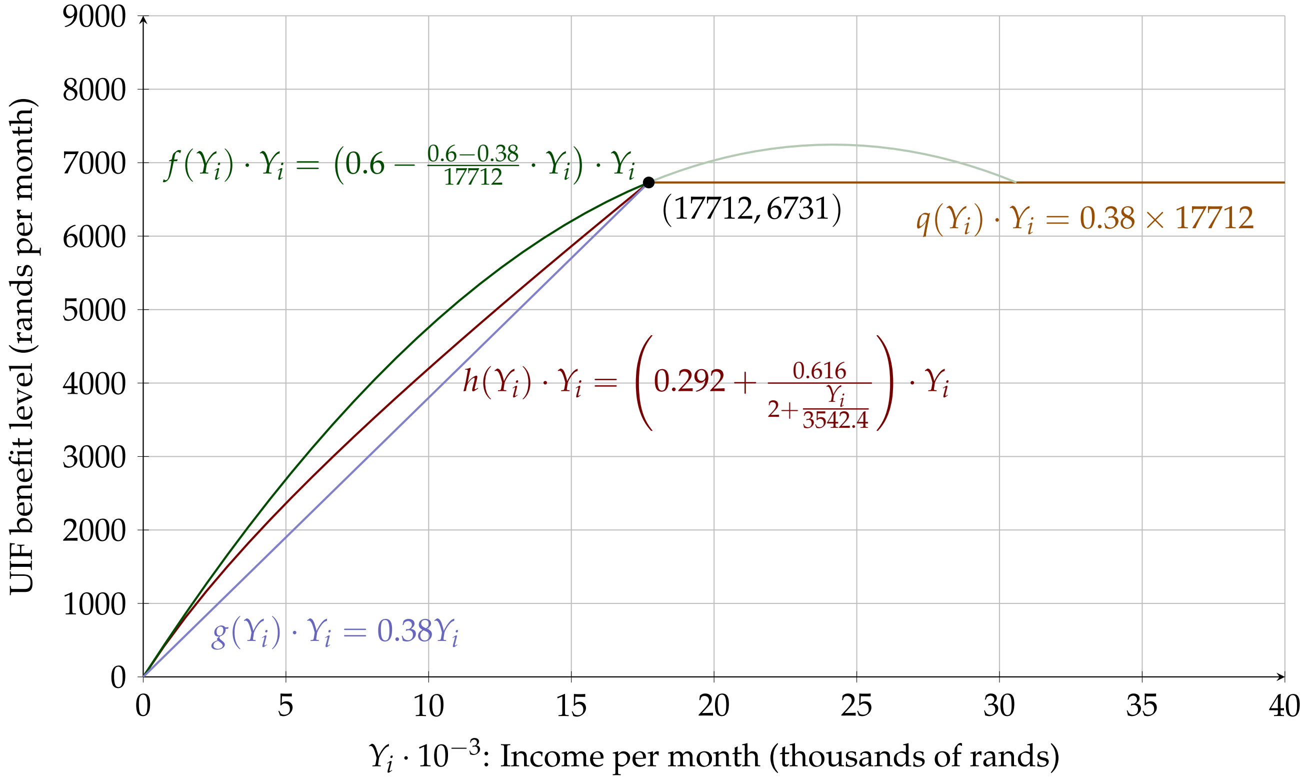
Figure 1: Existing IRR formula, and a linear one between the current URR and LRR



the existing formula is $h(Y_i)$, the hyperbola starting at zero earnings, whilst the flat benefit of $0.38 \times 17712 =$ R6730.56 produces an effective IRR of $q(Y_i) = \frac{0.38 \times 17712}{Y_i}$, shown as the hyperbolic curve from R17 712 onwards. The existing set-up is thus $h(Y_i)$ combined with $q(Y_i)$ (a split function). The (simpler) linear function (11) is shown in Figure 1 as $f(Y_i) = 0.6 - \frac{0.6-0.38}{17712} \cdot Y_i$, the dark green line from 0 to 17712. f could hypothetically be projected further than $Y_i = 17712$, to meet q at $Y_i = 30593$.

To see what the effect is on the realized benefit, observe Figure 2. Figure 2 shows that the sliding IRR concept gives a higher benefit payout compared to a constant IRR of 38% (shown as the faded blue straight line $g(Y_i) \cdot Y_i$). The transition between the existing function $h(Y_i) \cdot Y_i$ and the flat rate benefit $q(Y_i) \cdot Y_i$ is nonsmooth at Y_{LRR}. The easy-to-understand linear IRR function $f(Y_i)$ would result in a somewhat smoother transition at the benefit transition income level. It is possible for f to be used between R17 712 and R30 593, as a projection of the function will intersect q again at R30 593. This would result in a higher benefit level for those who earn between R17 712 and R30 593 per month, so assume that we would still choose the flat rate benefit q to take over from f at R17 712. An interactive version of this graph is available at https://www.geogebra.org/classic/dj6dedyd

Figure 2: Realized benefit levels under the existing IRR formula, and a simple linear one



4.1 Cost implication

One can see that the linear IRR function f above gives a higher cost to the government. We run simulations, shown in Appendix A, that uses the microdata from the Labour Market Dynamics in South Africa (LMDSA) 2018 dataset. This dataset contains information on the distribution of earnings in South Africa's labour market. The simulation works in the following manner.

1. Assign a UIF benefit to every individual in the labour market, based on their level of earnings (using the sliding scale formula, and benefit transition income level).

2. Multiply each individual's UIF benefit by their person weight, to see how each observation represents the population.

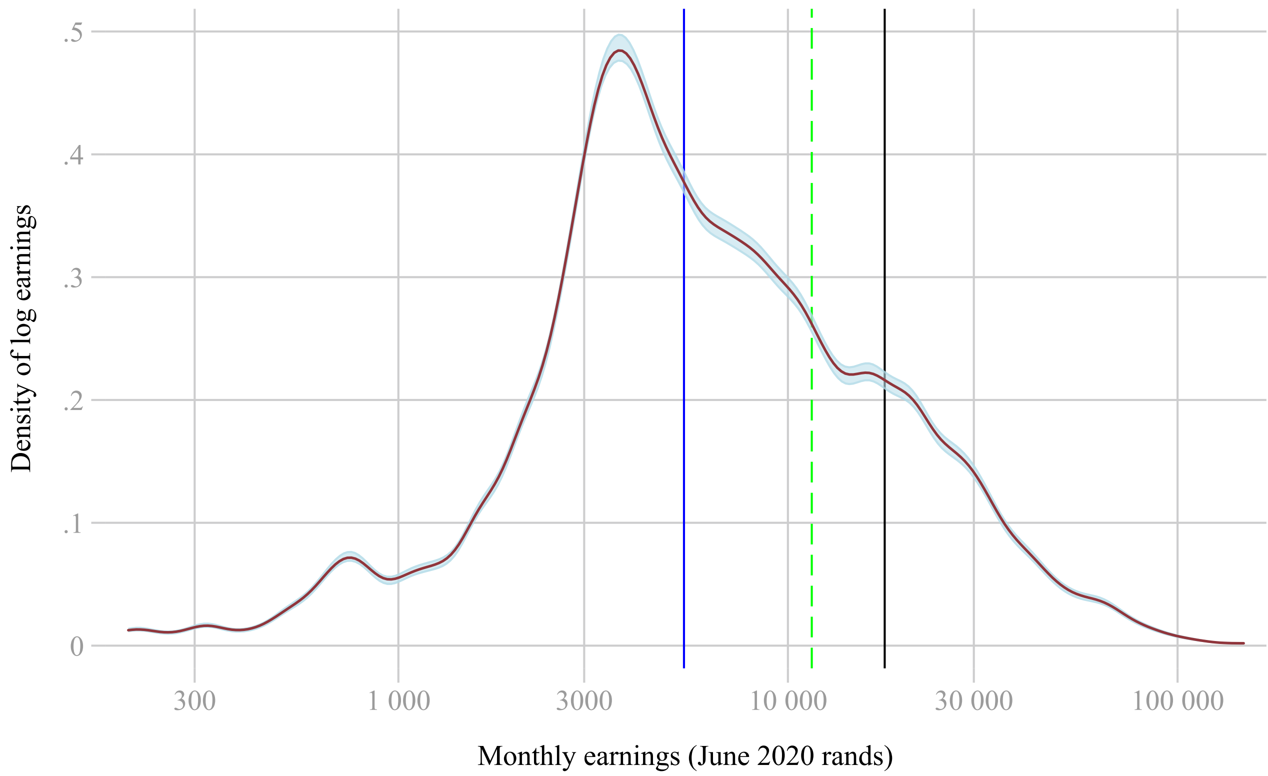
3. Aggregate those weighted benefits, to get a total cost to government.

This simulation tells us that the total cost of f would be 7.3% higher than the existing formula, without adjusting the parameters.

Seemingly, the contribution threshold (set in a different act) should also be as high as the benefit transition income level, as high earners have capacity to fund the programme sustainably. Recently, the benefit transition income level (R17 712 per month) has been set higher the contribution threshold (R14 872 per month), which should be revised. The current need for increased funding (due to the coronavirus lockdown) and liquidity constraint on the UIF could be solved with a higher contribution threshold. We now present a simulation to quantify what the effect would be on revenue. We estimate that raising the contribution threshold from the current R14 872 earnings per month to the same level as the benefit transition income level, R17 712, would increase the UIF revenue by 7.2% (see Appendix A). The closeness of this number with the increase in cost of the linear IRR function is a coincidence, but it does argue for making the two changes simultaneously.

To get an understanding of the mass of UIF-contributors at each level of earnings, observe the kernel density estimate in Figure 3. 84% of UIF-contributors earn below R17 712 (June 2020 prices). The density plot shows some evidence of bunching at the benefit transition income level, which shows evidence of a response to the kink in the realized benefit level. The 95% confidence band on the kernel density estimate is thin, so this bunching is statistically significant. Assuming that the Statistics South Africa (StatsSA) earnings data is good quality, smoothing out the kink in the benefit formula could therefore have a meaningful impact on gross salary decisions undertaken by employers.

Figure 3: Log gross earnings distribution in South Africa (2018): UIF-contributors only



Dashed light-green line shows mean monthly earnings (R11510).
Solid blue line shows median monthly earnings (R 5410).
Benefit transition income level: black line at R17712 (84% (0.22%) of the distribution below this number)
Standard deviation: 1.13 log earnings
95% confidence intervals shown in light blue

Source: PALMS 2018, with imputed earnings and UIF responses for missing data

Our source of data uses the earnings imputations provided by Kerr, Lam and Wittenberg (2019) for those who refused to divulge their earnings. This raises the mean level of earnings slightly, presumably indicating that more affluent people avoid divulging their income. Also, we find that the Quarterly Labour Force Survey (QLFS) questionnaire, whence the data come, does not ask *employers* if they contribute to the UIF or not (which employers would do if they pay pay-as-you-earn income tax), only employees. Therefore, we impute values for the UIF variable for employers using a probit regression, so as to include them in the sample.

4.1.1 The current mechanism for adjusting the total cost of nominal benefits

Currently, the mechanism to adjust the total cost of nominal UIF payments is to adjust the benefit transition income level, while keeping the LRR the same. This changes the flat rate benefit $q(Y_i) \cdot Y_i$ (i.e. shifts the horizontal orange line up or down). Although, the benefit transition income level (the black dot in Figure 2) is only allowed to move along, or above, the projection of the light-blue line $g(Y_i) \cdot Y_i$. That is because the light-blue line shows an LRR of 38%, and the *Unemployment Insurance Amendment Act, No. 10 of 2016* (2017: s17), changed the original act to prevent the LRR from being set below 38%. Section 17 of this amendment act is not well formulated. We quote it below, where **[bold text in square brackets]** indicates omissions, and underlined words indicate insertions.

> **Amendment of Schedule 2 to Act 63 of 2001**
>
> **17.** Schedule 2 to the principal Act is hereby amended by the substitution for the second paragraph under the heading "*Income Replacement Rate*" of the following paragraph:
>
> > "The IRR is at its maximum when income equals zero, and it reaches its minimum where income is equal to the benefit transition income level. The maximum IRR is **[fixed]** currently set at 60%. The minimum IRR is currently set at 38%. However, the Minister may, in consultation with NEDLAC vary the minimum **[IRR]** maximum income and flat replacement rate in terms of section 12(3)*(b)* but cannot reduce the minimum IRR to any percentage below 38. The Minister may from time to time after consultation with Parliament, vary the IRR and the benefit period by regulations.".

(*Unemployment Insurance Amendment Act, No. 10 of 2016*, 2017: s17)

The third change was aimed at preventing the minister from lowering the LRR. The amendment reiterated that the minister may adjust the benefit transition income level. However, the change was not captured correctly, as the wording does not make sense: what is "minimum maximum income"? The word "minimum" should have been omitted as well, but it was not.

The final change, firstly, states that the LRR cannot be lowered. Section 12(3)*(b)* states that the URR cannot be raised above 60%. (This is not necessarily a problem in relation to the sweeping changes to the formula that our paper proposes, as the new formula would change the entire Schedule 2.) The spirit of the law was to restrict the shape of the realized benefit level function (Figure 2) somewhat, so that the benefit transition income level has an upper bound. It puts a limit on regressivity. That is, the *shape* of the benefit level function determines how lower-income people benefit in relation to higher-income people.

As a thought experiment, consider how the shape of the benefit level function can be changed. In order to increase total nominal government expenditure, shifting the benefit transition income level *horizontally* to the left (which also increases the LRR) would increase progressivity—it would benefit lower-income people more than higher-income people. In order to decrease total nominal expenditure, shifting the benefit transition income level horizontally to the right (which also decreases the LRR) would increase regressivity, as payments are only reduced for lower-income people.

In the last sentence of the amendment, hopefully "vary the IRR [formula]" gives license to change the formula.

4.1.2 Aligning the cost of the new formula with present costs

When we propose adjustments to the formula itself, we do not think the restrictions on the URR and LRR need apply. This is because a change to the formula changes the shape, even if the URR and LRR remain the same (at 60% and 38%). When reforming the formula, it makes more sense to adjust the parameters to align present costs with the cost under the new formula, while keeping the flat-rate benefit paid to high-income earners the same. Shifting the transition income level horizontally to the right on the realized benefit level function (to account for the increase in cost of the new formula) amounts to simply redistributing income from people earning around the present transition income level, to people earning well below the present transition income level. In this sense, this is a progressive reform. Further adjustments to the total expenditure can certainly be made, through the relevant parameters defined in the legislation.

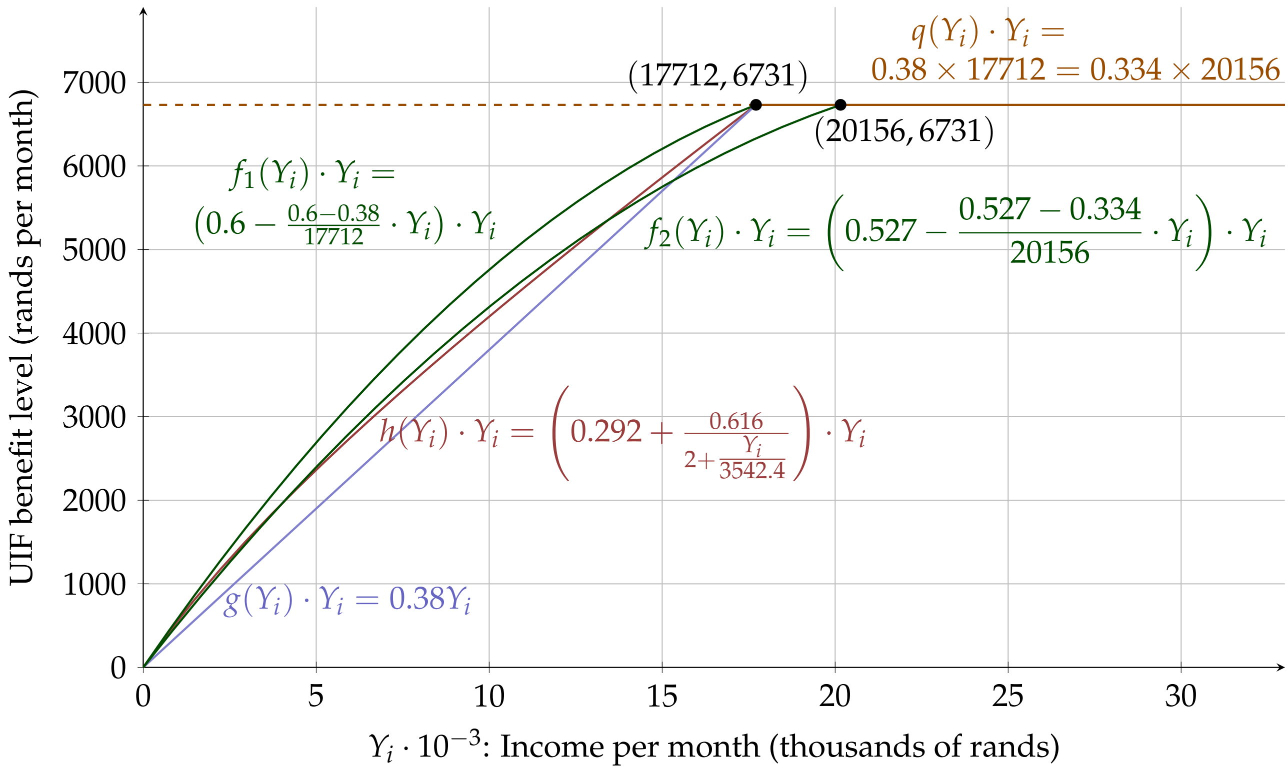
Those who consider the reforms that our paper encourages may wish to simply keep the URR the same (60%). However, we come across an interesting finding that if only the LRR and transition income level are adjusted in the linear formula presented above, the total cost cannot be reduced past a certain point (a transition income level of R22 435, giving a total cost that is 5.7% higher than the original formula). That point is the point of tangency between f and q, as the transition point slides to the south-east along q in Figure 1. One can imagine this when looking at Figure 1, as the green linear line will start to swing upwards, beyond the point of tangency, and the realized benefit will rise above the flat-rate benefit for a portion of the domain. Perhaps this is why the existing formula was created, as with the existing formula, this problem does not exist.

In the next section, we explore this point of tangency in greater detail, but for the moment, we need a solution to reduce the total cost. Our solution is to expand (stretch) the function $f \cdot Y_i$ rightwards, in Figure 2. This will lower both the URR and the LRR with the same proportion, while we keep the flat rate benefit at R6731.

One can estimate a hypothetical total cost to government for UIF benefit payments, based on earnings microdata, as shown in Appendix A. In the routine shown in Appendix A, we assume that there is 100% claims coverage of all workers, although this is not without loss of generality, as we are merely using this assumption to compare the two different functions. The routine runs quickly, so it does not take long to guess-and-check the adjustment to align the costs (knowledge of an optimization method fails the author at present).

Using this simulation, we find that expanding the realized "linear" function $f_1 \cdot Y_i$ to the right by a factor of approximately 1.1385 will equate the present total cost with the new total cost. This gives a URR of about 53%, and an LRR of about 33%, with the benefit transition income level at $6731/0.334 =$ R20 156. Figure 4 shows the equal-cost formula as f_2.

Figure 4: Linear IRR formula, with an equal cost to government as the existing one



Workers earning between R4 019 and R13 438 would gain a higher UIF benefit, whilst those earning between R13 438 and R20 156 would receive a lower benefit. The difference below R4 019 is marginal, although these workers would receive a slightly lower benefit, due to a lower URR.

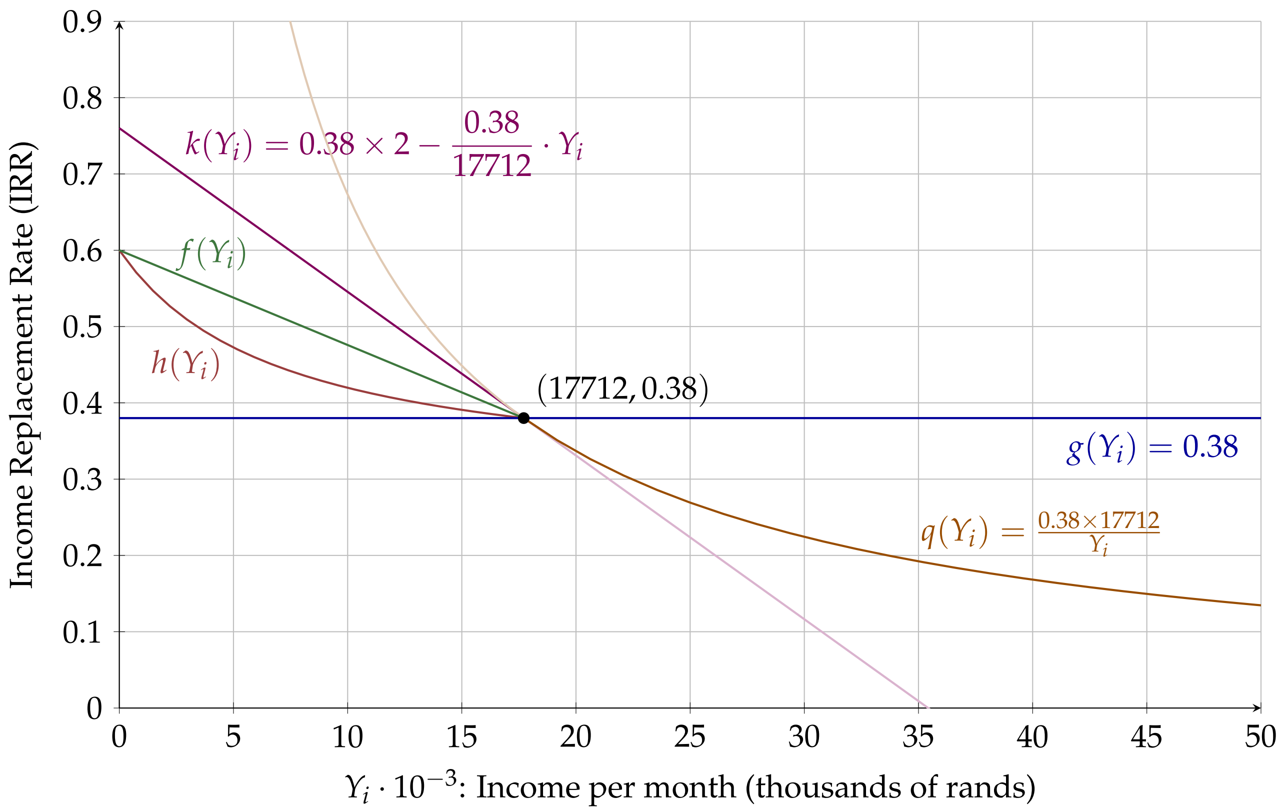
5 A tangential linear IRR function

Seeing as f would result in a *smoother* transition at Y_{LRR}, it raises the question whether we could choose an optimally smooth function, and whether that functional form would also be simple to understand and communicate to the general public. To construct this function, let us stick to a linear function for the IRR up to the benefit transition income level, and let us take the tangent to the flat rate benefit hyperbola, so that the kink is smoothed out. This will result in

$$IRR = URR - \frac{LRR}{Y_{LRR}} \cdot Y_i \tag{12}$$

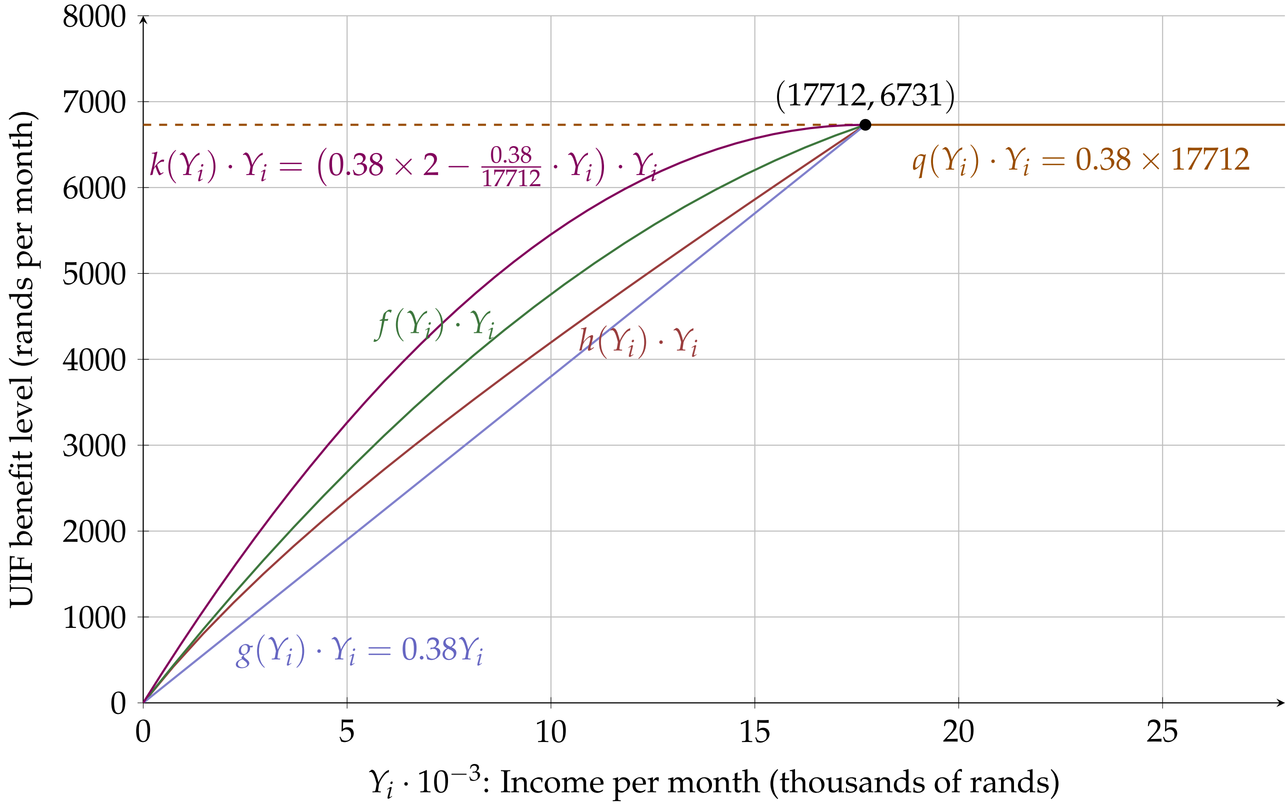
where we have the restriction $URR \equiv 2 \times LRR$. Call this function k. We have drawn k in Figure 5 and the realized benefit levels in Figure 6.

Figure 5: Tangential Income Replacement Rate formula



Observe the perfectly smooth transition from $k \cdot Y_i$ to $q \cdot Y_i$ on the realized UIF benefit graph. There is a slight challenge with k though, with the identity $URR \equiv 2 \times LRR$. This identity can be proved as follows. The tangent is found under two conditions. Firstly, the

Figure 6: Realized benefit levels, showing the tangential IRR formula



two functions intersect each other:

$$\frac{LRR \times Y_{LRR}}{Y_i} = URR - \frac{URR - LRR}{Y_{LRR}} \cdot Y_i$$

$$\implies \qquad LRR \times Y_{LRR} = URR \cdot Y_i - \frac{URR - LRR}{Y_{LRR}} \cdot Y_i^2$$

$$\implies \qquad \frac{URR - LRR}{Y_{LRR}} \cdot Y_i^2 - URR \cdot Y_i + LRR \times Y_{LRR} = 0$$

$$\implies \qquad Y_i = \frac{URR \pm \sqrt{URR^2 - 4LRR(URR - LRR)}}{\frac{2(URR-LRR)}{Y_{LRR}}}$$

Then note that the determinant $URR^2 - 4LRR(URR - LRR)$ is only nonzero when there is more than one point of intersection. The point of tangency has only one point of intersection, so set the determinant to zero. Secondly, we already know that the point of intersection happens at $Y_i = Y_{LRR}$, as that is the transition point, so substitute that value in.

$$Y_{LRR} = \frac{Y_{LRR} \cdot URR}{2(URR - LRR)}$$

$$\implies \quad 2(URR - LRR) = URR$$

$$\implies \quad URR = 2 \times LRR \qquad \blacksquare$$

This restriction gives $URR = 76\%$, which is below 100%. (At the minimum wage of R3500 per month, it is 68.5%.) 2 is a whole number, so the formula would be fairly simple, when deciding on the URR and LRR (simultaneously). This restriction is the price we pay for having an optimal function, although this option is in the author's opinion a better circumstance than letting URR and LRR be free, but having a hugely complicated function (1).

5.1 Cost implication

The next concern to deal with is that (12) would result in greater expenditure by government (if Y_{LRR} remains the same), as can be seen in Figure 6. In order to find k such that government expenditure is likely to remain unchanged, one can shift Y_{LRR} horizontally to the right, while keeping the benefit paid to high-income earners people the same. This would effectively modify the LRR according to

$$LRR_2 = \frac{Y_{LRR,\,1} \times LRR_1}{Y_{LRR,\,2}} \tag{13}$$

where the "1" subscript signifies the existing parameters used for h, and the "2" subscript signifies the parameters used for k, in order to keep the flat-rate benefit the same. Using the respective simulation for this formula in Appendix A, we find that

$$Y_{LRR,\,2} = \text{R24 910} \tag{14}$$

and

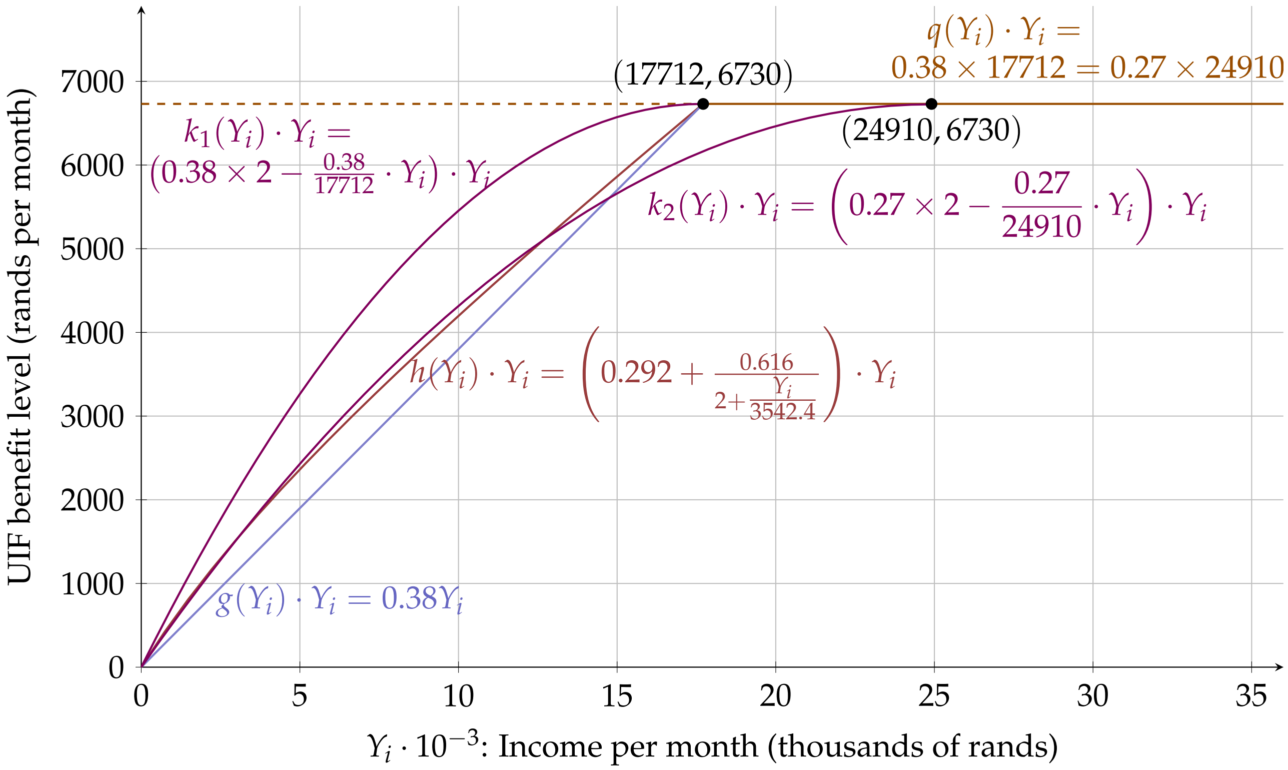
$$LRR_2 = 27\% \tag{15}$$

$$\implies \quad URR_2 = 54\% \tag{16}$$

give an approximately equal expenditure by the government, as shown in Figure 7.

In Figure 7, observe how workers earning between R3 086 and R12 710 would receive a higher UIF benefit, but those earning between R12 710 and R24 910 would receive a lower UIF benefit (the difference below R3 086 is marginal). This is desirable as it is a more progressive approach to social assistance (i.e. money is directed more towards low-income people), and the other advantage is that the transition of benefits from $k \cdot Y_i$ to $q \cdot Y_i$ is smooth.

Figure 7: Proposed IRR formula, with an equal cost to government as the existing one



6 Conclusion

This paper criticized the complexity of the sliding scale IRR formula. It is not easy to understand, and hence detracts from the transparency and accountability requirements of a sound social security system. Furthermore, the difficult side of the split function is only for earners who earn below R17 712 per month (above that wage, there is a flat-rate benefit). These earners are less likely than high earners to be comfortable doing complicated mathematical calculations, about their income. This means that it is not transparent. Other users of the formula include government bureaucrats and employers. The existing income replacement rate formula is

$$IRR = LRR + \frac{URR - LRR}{\left(2 + \frac{5Y_i}{Y_{LRR}}\right)\left(\frac{1}{2} - \frac{1}{7}\right)} - \frac{URR - LRR}{\frac{7}{2} - 1} \tag{2}$$

The simplified version of the formula (6) does not show the parameters, so users are also likely to have faced an incomplete understanding of the graphical representation of the function.

The linear function from $(0, URR)$ to (Y_{LRR}, LRR) is simpler, and provides a smoother transition of benefits at the transition point. However, it is possible in the long-run for this function to give realized benefits above the flat-rate benefit, so we recommend rather using the linear IRR function that is tangential to the flat-rate benefit hyperbola. This function is

$$IRR = LRR \times 2 - \frac{LRR}{Y_{LRR}} \cdot Y_i. \tag{12}$$

It is simple, provides a perfectly smooth transition of realized benefits at the transition point, and is more progressive in the distribution of benefits. Since the same parameters for LRR and Y_{LRR} as in equation (2) would increase government expenditure, the Minister could set $LRR = 27\%$ and $Y_{LRR} =$ R24 910 to give a roughly equal level of total expenditure. The only caveat of this proposed formula is that the URR must be chosen in conjunction with the LRR, to obey the identity $URR \equiv LRR \times 2$, however, we believe that this restriction is relatively easy to understand.

7 References

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A Stata routine to estimate the cost to government of UIF benefit payments

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* Simulation of the cost to government of a UIF benefit
* PALMS, 2018, June 2020 rands
* Aidan Horn (hrnaid001@myuct.ac.za)
* Southern Africa Labour and Development Research Unit, University of
   Cape Town
* April 2020 to Jan 2021

window manage forward results
* Do not -clear all- the scalars from memory.
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* Please click on View > Wrap lines     (at least in newer versions of
   Stata)

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log using "$SAVE/Scripts/Logs/Comparing costs", replace

* This .do file carries on from "imputation.do". See Aidan's GitHub
   repository version release, accompanying the TERS paper.
* PALMS, updated with the LMDSA 2018 by Aidan Horn, and including
   DataFirst's imputed earnings routine (for refused responses and
   outliers, raising mean earnings), and Aidan's imputation of the UIF
   variable for employers. Sample restricted to UIF-contributors only
   (-keep-).
use "$SAVE/DataOUT/PALMS2018imputedUIF.dta", clear

* realearnings base month was December 2017, but the loaded dataset
   inflated it to June 2020, using the Headline CPI.


* use bracketweight for earnings analysis (see the PALMS User Guide)



/*********************************************************************
                    Existing IRR formula
*********************************************************************/

scalar LRR = 0.38   // Lower income replacement rate
scalar URR = 0.6    // Upper income replacement rate
scalar transition = 17712   // benefit transition income level

generate  UIFbenefit = .
replace UIFbenefit = (LRR + (URR - LRR) / ((2 + realearnings * 5 /
   transition) * (0.5 - 1 / 7)) - (URR - LRR) / (7 / 2 - 1)) *
   realearnings if realearnings >0  &  realearnings < transition    //
   formula from the UIF Act
replace UIFbenefit = LRR * transition  if realearnings >= transition &
   realearnings <.
* replace UIFbenefit = 0  if realearnings > cutoff
```

```
gen bracketweight_annualized = bracketweight/4
summarize bracketweight_annualized, detail
di r(sum)   // This is the population size that we're using.

generate UIFbenefitXweight = UIFbenefit * bracketweight_annualized
   // bracketweight sums up to the population size each quarter.
summarize UIFbenefitXweight, detail     // This is the distribution of
   the weighted UIF benefit. It isn't that useful, because each
   observation represents a different number of people.
scalar UIFcost = r(sum)

display  UIFcost


/*********************************************************************
                Proposed linear IRR formula
*********************************************************************/

scalar expand = 1.1385      // expand the realized benefit formula
   rightwards, to reduce costs
scalar L_LRR = LRR/expand   // new LRR, to keep the flat-rate benefit
   the same for high-earners
scalar L_URR = URR/expand   // reduce the URR in the same proportion
scalar L_transition = transition*expand // benefit transition income
   level (increase to reduce costs)

generate  L_UIFbenefit = .
replace L_UIFbenefit = ( L_URR - (L_URR - L_LRR)/L_transition *
   realearnings ) * realearnings  if realearnings >0  &  realearnings <
   L_transition   // linear formula
replace L_UIFbenefit = L_LRR * L_transition  if realearnings >=
   L_transition & realearnings <.
* replace L_UIFbenefit = 0  if realearnings > cutoff

generate L_UIFbenefitXweight = L_UIFbenefit * bracketweight_annualized
summarize L_UIFbenefitXweight, detail
scalar L_UIFcost = r(sum)

display  L_UIFcost


/*********************************************************************
                Proposed tangential IRR formula
*********************************************************************/

scalar T_transition = 24910 // benefit transition income level (set
   manually iteratively, as I'm not sure how to optimize this)     //
   used to be 24830
scalar T_LRR = ( transition * LRR ) / T_transition      // new LRR, to
   keep the flat-rate benefit the same

generate  T_UIFbenefit = .
replace T_UIFbenefit = ( T_LRR*2 - T_LRR/T_transition * realearnings ) *
   realearnings if realearnings >0  &  realearnings < T_transition    //
   tangential formula
replace T_UIFbenefit = T_LRR * T_transition  if realearnings >=
```

```
   T_transition & realearnings <.
* replace UIFbenefit = 0  if realearnings > cutoff

generate T_UIFbenefitXweight = T_UIFbenefit * bracketweight_annualized
summarize T_UIFbenefitXweight, detail
scalar T_UIFcost = r(sum)

display  T_UIFcost

**********************************************************************

* Analyzing various contribution thresholds
foreach contributionthreshold of numlist  178464  212544  240000  275000
    {
    di " "
    di " "
    cap drop annualuifcontribution uifcontributionXweight

    gen annualuifcontribution=0 if realearnings!=.
    qui replace annualuifcontribution = realearnings * 12 / 100 * 2 if
       isuif==1     // UIF contributions should probably exclude bonus
       payments, which we haven't taken into account here.
    di "Number of people in the sample above the threshold:"
    replace annualuifcontribution = `contributionthreshold' / 100 * 2
          if realearnings * 12 > `contributionthreshold'  &
       realearnings<.

    * summarize realearnings, detail    // restricted to UIF-contributors
    summarize annualuifcontribution, detail
    di "Sum: `=round(scalar(r(sum)))'"

    generate uifcontributionXweight = annualuifcontribution *
       bracketweight / 4     // weight sums up to the population size
       each quarter
    summarize uifcontributionXweight, detail
    scalar annualcontributiontotal_`contributionthreshold' = r(sum)

    di "For an annual individual contribution threshold salary of
       R`contributionthreshold',"
    local di_contributiontotal_m : di %7.0g
       annualcontributiontotal_`contributionthreshold' / 10^6
    di "Total annual contributions amount to `di_contributiontotal_m'
       million  (2020 Q2 rands)"
    di ""
    scalar Multiple = 20.25*10^9/annualcontributiontotal_178464
    local di_total_m_uprated_`contributionthreshold' : di %7.0g Multiple
       * annualcontributiontotal_`contributionthreshold' / (10^6)
    di "To align this with R20.25 billion actual contributions in
       2018/2019 (in 2020 Q2 rands), we multiply this total by
       `=scalar(Multiple)', to get
       `di_total_m_uprated_`contributionthreshold'' million 2020 Q2
       rands"
}


di UIFcost
```

```
di L_UIFcost
di (L_UIFcost - UIFcost)/UIFcost * 100
di T_UIFcost

di L_LRR
di L_URR

di T_LRR



cap log close
exit, clear
```

Founded in 1975, the Southern Africa Labour and Development Research Unit (SALDRU) is a research-based social responsiveness initiative housed in the School of Economics at the University of Cape Town.

The unit carries out research and capacity building in applied empirical microeconomics with an emphasis on poverty and inequality, labour markets, human capital and social policy. We strive for academic excellence and policy relevance.

SALDRU has implemented a range of innovative surveys in South Africa including the Project for Statistics on Living Standards and Development (PSLSD), Cape Area Panel Study (CAPS) and the National Income Dynamics Study (NIDS), among others. Building on these large data gathering projects, we conduct a range of training and capacity building activities in the use of survey data to analyse social well-being.

Our mission is to challenge inequalities through policy relevant academic research.

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