The Real Retirement Life Income Fund

An Inflation Protected, Dignified Standard of Living for all Singaporeans

MBA Management Practicum Project
Research Working Paper
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1.0 Executive Summary

The greying population tsunami is weighing on the minds of sovereign governments internationally, and Singapore is no exception. Governments are grappling with how to plan and prepare for this dramatic demographic shift and ensure the well-being of their citizens in retirement.

High profile failures have seen the slow decline of the defined benefit pension schemes and the transition towards defined contribution plans. However, many questions still arise about how these funds should be invested to ensure long term security.

Retirement planning is difficult due to its long term nature and the consequentially high degree of uncertainty. Understanding and managing the risks associated with life expectancy, inflation, and investment rate of return is difficult for governments and the financial industry, and almost impossible for the general public who often lack the financial literacy necessary to make informed decisions. The internet is awash with retirement calculators and planners which attempt to assist the layman in planning for their future, yet they are based on assumptions and advise that are often incorrect, wishful, and non-transparent.

Although our article applies to any country interested in or thinking about providing a social safety net level of retirement income to its citizenry, Singapore is well placed for this study given the institutionalised culture of retirement savings through the Central Provident Fund.
(CPF). Yet government guaranteed CPF interest rates are failing to keep up with inflation, which is currently running at 5.5 per cent.¹

This management practicum proposes the Real Retirement Life Income (RRI) Fund, a sovereign managed retirement scheme for Singapore, administered by the CPF. The RRI Fund invests monthly and lump sum contributions directly into inflation-protected securities and ensures a guaranteed, safety-net level of real cash flows from retirement to death, which is sufficient to maintain a dignified standard of living for all Singaporeans.² An Excel-based financial calculator has been developed in tandem with this analysis so as to calculate the required monthly contributions for households based on their current capabilities and preferences. The RRI Fund calculator is designed to minimise assumptions and ambiguity, whilst providing the flexibility required to cater for individual circumstances. The RRI Fund Calculator uses current and estimated real cash flows for a household to estimate the real monthly contribution that will ensure a level of real income in retirement that will allow for a dignified standard of living. The real discount rates are obtained based on market expectations of the real term structure, thus providing a certain hedge against inflation. At the same time, instead of assuming a flat term structure based on historical data, the real term structure used in the RRI Fund Calculator is obtained from market inflation-indexed bond rates.

¹ Trading Economics website
² Since inflation-indexed bonds are not yet available in Singapore, we propose using inflation bond-replication strategies here, as proposed in the recent academic literature.
This management practicum represents a part of an overall larger project to design a web-based retirement calculator and overall investment strategy to enable the RRI Fund to be potentially implemented at a national level. The outcomes from this study can also be applied to any country facing a retirement saving and investing problem with aging demographics.
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2.0 Introduction

The greying population tsunami is sweeping towards Singapore. Whilst only 1 in 12 Singaporeans were over the age of 65 in 2005, by 2030, that number will have increased to a staggering 1 in 5.\(^3\) Despite the high levels of savings, the present CPF system will potentially struggle to provide sufficient funds for Singaporeans in retirement due to inadequate returns and in the face of unpredictable and high inflation.

This management practicum analyses the current challenges in planning for retirement and the inadequacies of the current CPF system. It proposes an alternative retirement model, the Real Retirement Life Income (RRI) Fund based on inflation-protection and life-time guarantee to ensure a dignified standard of living for all Singaporeans. An Excel-based financial calculator has been developed to determine the monthly and lump sum contributions required by households in a manner that reduces ambiguity and assumptions. Finally, the limitations of the retirement calculator and the future steps required to develop our program into a national social safety net retirement plan for Singapore are addressed. Although our approach applies to any country interested in or thinking about providing a social safety net level of retirement income to its citizenry, our current focus is on Singapore.

3.0 Planning for Retirement

How to plan for retirement is a key question facing individuals and governments internationally. The demographic transition towards an aging population is forcing the transition from defined benefit to defined contribution models of retirement financing, and with this transition comes a new raft of questions and challenges.

For the individual the fundamental issue is how much does one need to ensure that one can maintain one’s standard of living for life. For the government the fundamental issue is how to provide their citizens with the financial planning support and investment options they require to maintain this standard of living with minimal reliance on the public purse.

These questions are challenging as they concern not only the management of assets, which requires a degree of financial literacy that is often beyond the average citizen, but also the management of risk. Retirement is full of uncertainty. Uncertainty about how long you will live; uncertainty about what a dollar today will buy you tomorrow; and uncertainty about life events.

To assist in financial planning for retirement, many individuals turn to the myriad of online retirement calculators. These tools typically ask a number of questions about current age, income, assets, liabilities, and desired retirement age, and then apply a number of assumptions about life expectancy, financial requirements post retirement, inflation, and

pre- and post-retirement rates of investment return. As is often the case, it is from these assumptions, applications, and recommendations that many errors emerge.

Life expectancy is one such assumption which is often calculated based on average expectancy or with some degree of error imbedded. If it is based on average expectancy there is a reasonably good chance that you will outlive the prediction. Desired annual income is another tricky assumption. Certain calculators will try to determine it based on a proportion of current disposable income; in doing so they take into account the fact that mortgage repayments and other liabilities are likely to have ceased upon retirement. Alternatively, a pre-defined portion of your pre-retirement salary may be used, typically 70-85% as is often recommended by financial planners. The calculator may allow you to select the desired annual income directly, which requires the user to have a depth of financial understanding that is often not typical nor within the individual’s ability.

Inflation and investment rates of return, both pre- and post-retirement, are highly influential on the output of the calculator. Yet, as has been evident in recent years, these variables can be highly volatile and difficult to predict. Consequently, outputs can be grossly conservative or generous.

To demonstrate the impact of assumptions within calculators, Bonnie Biofore (2007) compared five online retirement calculators in the U.S.A. The range of additional monthly savings required ranged from $2,100 to $7,700. Whilst most calculators will clearly state

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7 Ibid
the assumptions that have been applied, for the average citizen approaching retirement, they may struggle with the financial literacy required to understand the implications.

Finally, when it comes to planning for retirement, what one should be doing with one’s money, at a minimum, is to ensure that the average citizen is able to maintain her basic standard of living for the rest of her life. With the vast number of investment options that exist out there, how can governments support their citizens to make sound choices which effectively manage risk?

4.0 Retirement in Singapore

In Singapore, the predominant source of retirement funds comes through the Central Provident Fund (CPF), a compulsory savings plan, which is administered by the CPF board, a statutory body under the Ministry of Manpower. The CPF however, is more than a pure retirement plan. Its “comprehensive social security savings plan” encompasses healthcare, home ownership, asset enhancement and family protection. The compulsory contribution rate varies from 36 per cent to 11.5 per cent of income depending on age.

The CPF is administered through a complex series of accounts with varying purposes and interest rates. Government-guaranteed interest rates vary from 2.5% for the ordinary account (OA), to as much as 5% within the Special, Medisave and Retirement (SMR) accounts. The interest rates are reviewed on a quarterly or yearly basis depending on the

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8 CPF website, Overview page.
9 Ibid
account. The interest rates are determined by the prevailing market rates for 12-month fixed deposits (for the OA), and the average 12 month yield for 10 year Singaporean Government Securities (for SMR accounts). Presently, there are additional bonuses of 1% paid above these rates for the first $60,000 in your CPF account. These interest rates represent a floor, or the minimum guarantee, and they can be higher (or lower).

Upon reaching 55, Singaporeans are able to withdraw their retirement funds with the exception of a Minimum Sum, currently set at $120,000 (in 2003 dollars), which can be kept in the CPF, invested in specific banks, or used to purchase a life annuity from specific insurance funds. If the Minimum Sum\(^{10}\) remains within the CPF or is invested within one of the selected banks, the retiree will receive a monthly payment until the money is exhausted. A recently introduced program called CPF-LIFE provides a lifetime monthly payment in nominal terms, the size of which is dependent on the balance in your retirement account when you commence draw down.\(^{11}\)

The mission of the CPF is “[t]o enable Singaporeans to have a secure retirement.” Criticisms of the CPF system tend to revolve around the following themes:

1. Failure to protect against inflation risk.

2. Payout amounts are highly reliant on the prevailing interest rates, so it is difficult to provide certainty.

3. Limited protection for unexpected longevity.

\(^{10}\) CPF website, Overview page.

\(^{11}\) Ibid
4. Whilst the system does allow for a degree of flexibility, its current complexity means that it is beyond the financial literacy of the average Singaporean.

Even though, the CPF is currently yielding attractive risk-free rate of returns, it is not indexed against inflation, thus leaving retirees exposed. Whilst it has been argued that there is a certain amount of protection provided by the fact that CPF provides the prevailing nominal risk-free rate of return, which should move in line with inflation, decoupling has been observed in recent years.

Figure 1 shows that the CPF guaranteed rate of return has been consistent at 4 per cent whilst the Consumer Price Index (CPI) has moved independently. Figure 2 demonstrates a high level of volatility in inflation which in recent times has peaked again at 5.5 per cent, well above the 4 per cent CPF rate of return. The consequence is that the savings of Singaporeans that are not protected from these volatile moves in inflation are going backwards in real terms.
Whilst the interest rates provided by the CPF are attractive risk-free rates of return compared to the proxy risk free rate as set by the Monetary Authority of Singapore, they are prone to fluctuations, which lead to uncertainty. Deregulation has allowed the option for contributors to allocate their CPF monies to a number of permissible investments including unit trusts and investment-linked insurance products.\(^\text{14}\) However, these are not only highly confusing investment choices, but are risky as well. Example, the former doesn’t provide a guaranteed rate of return, while the latter could face counterparty risk. As Sadler (2006) demonstrates, the Minimum Sum of $120,000 will yield approximately $1,000 per month for 20 years, which as will be discussed later, is inadequate.\(^\text{15}\)

\(^{12}\) SingStat website, CPI page & CPF website, Interest Rate page.

\(^{13}\) Trading Economics website.

\(^{14}\) Koh, B. 2010.

\(^{15}\) Sadler, J. 2006.
Finally, the introduction of life annuities and the CPF-LIFE scheme has addressed the concerns about unexpected longevity to some extent. Whilst payments will be guaranteed for life, this guarantee comes at the expense of lower payments, **which are not inflation protected**. The online CPF-LIFE Payment Estimate indicates that a 57 year old now with an anticipated balance of $120,000 can expect a payment of between $823 and $899 based on current CPF interest rates of between 3.75% and 4.25%. Once again, these rates are not guaranteed over the 57 year old’s life. Furthermore, the impact of inflation is not considered.

In our view, the current CPF system is administered in a highly complex manner. It involves multiple accounts with various purposes each attracting different interest rates and involving bonuses to capped levels! A brief glance at the CPF website can leave the individual feeling more confused than informed. This degree of complexity is beyond the financial literacy of most Singaporeans. Additionally, whenever there are changes to the system, they are often inadequately communicated and poorly understood.\(^{16}\)

As Singapore is aging, with 1 in 5 expected to be over the age of 65 by 2030,\(^ {17}\) CPF will struggle to maintain the needs, let alone the wants of the vast majority of Singaporeans. The government needs to be considering alternative models moving forward, whilst keeping it simple to understand and easy to implement.

\(^{16}\) Eu, S et al, 2011.

5.0 An Inflation Protected Dignified Standard of Living For All Singaporeans

5.1 Overview of the Real Retirement Income (RRI) Fund

So far we have considered the challenges the individuals and governments face in planning for retirement. In particular we have noted the difficulties that arise from the:

1. Uncertainty of life expectancy
2. Impact of Inflation
3. Inappropriate advise on the use of risky investments for retirement, and the associated assumptions

The Real Retirement Life Income (RRI) Fund is proposed to address these concerns and provide a dignified (basic) standard of living in retirement for all Singaporeans. Given its objective and construction, one can also refer to it as the “social safety net” real retirement life income fund.

The sovereign-managed RRI Fund allows Singaporeans to make appropriate monthly contributions, which in turn are invested with return guarantees in excess of the inflation rate (i.e., real returns). Upon retirement, these savings are then used to purchase an inflation-indexed product such as a life annuity or insurance policy, which will guarantee an inflation-protected level payment for the rest of one’s life. In doing so, we address the first two concerns above.

In conjunction with the RRI Fund, a survey tool called the RRI Fund Calculator has been developed to calculate the monthly contributions required. In order to address the third
concern discussed above, this calculator has been deliberately designed to minimise or avoid the ambiguities of assumptions, whilst still allowing the individual the flexibility to tailor contributions to their own circumstances.

5.2 The Real Retirement Life Income Fund

The RRI Fund, as described above, is designed to provide a level and steady stream of real cash flows from retirement until death, sufficient to provide a dignified standard of living in retirement.

The term ‘dignified standard of living’ is deliberately used to reflect the fact that the RRI Fund is designed to provide all Singaporeans with a “safety-net” income that is greater than merely subsistence. Subsistence, by definition, is the act of maintaining oneself at the minimum level. However, some may argue that Singapore being a wealthy and prosperous nation can strive to achieve more than the ‘minimum level’ for its retiring citizens after a life-time of hard work. It is therefore reasonable to consider not only the needs but also the wants of the retiring generation in determining what income will be required. However, the RRI Fund is also designed for all Singaporeans. As a consequence, the level of contributions (and ultimate retirement income) must therefore be achievable for all Singaporeans; hence, pragmatism is required. How much real income is required to maintain a dignified standard of living is explored in Section 5.4.

The RRI Fund will receive monthly contributions and lump sum payments from individuals. The proposed investment strategy for the RRI Fund is to invest in a direct (or replicated) inflation-protected security. Upon retirement, these funds will be used to similarly purchase an inflation-protected life annuity guaranteeing real cash flows until death.
5.2.1 The Importance of the Sovereign Involvement and Guarantee

The proposed RRI Fund is a sovereign managed fund. Given the impact and demands that retirement can place on the national economy the close involvement of the sovereign is not only unavoidable but essential.

Given the long maturities involved with retirement planning, implicit or explicit sovereign guarantees are warranted as repeated financial failures remind us of the large counterparty risk associated. The explicit sovereign guarantee will lower the cost of buying insurance for credit risk (such as credit default swaps), whilst at the same time boost participation to the levels required to reduce transaction costs and mitigate the longevity risk.

The RRI Fund will also provide inflation risk protection. Many studies in this field have shown that the sovereign is arguably the best and most credible institution to provide inflation risk protection due to the positive correlation of sovereign income and inflation. The sovereign can do this either by directly issuing inflation-indexed securities (such as US Treasury Inflation-Protected Securities (TIPS)) that an investment manager or plan sponsor can invest in, or by providing guarantees to such a retirement planning fund. Whilst it is beyond the scope of this paper to propose a detailed methodology for replicating inflation-protected securities, Section 5.2.2 briefly discusses the various options available to sovereigns and investment managers in achieving this objective.

Various scholars have shown that the sovereign should have limited scope of guaranteeing only the subsistence standards of living for a household in retirement. The RRI Fund challenges this approach and argues that a fully funded, sovereign managed scheme that addresses both inflation and longevity concerns can achieve guarantees beyond subsistence to those of a dignified standard of living.

5.2.2 Protecting against Inflation: An Inflation Indexed Bond Replication Strategy for Emerging Economies

Many studies have rightly suggested that retirement funds need to be protected against rises in the consumption index. This seems appropriate given that what we are trying to protect is the amount that retirees can consume. However, in order to achieve this protection, funds need to be able to invest in securities that are based on that index. Presently, there are inflation-indexed securities, but no consumption-indexed securities. Consequently, the RRI Fund must provide inflation protection rather than consumption index protection.

As illustrated by Bodie, Cherian & Chua (2011) the preferred investment for such a retirement fund is sovereign-issued inflation-indexed bonds similar to the US TIPS. However, most countries in emerging economies, including Singapore, lack such securities and hence it becomes imperative to replicate a country specific, inflation indexed portfolio with a set of other securities in a robust and cost effective manner. In the same paper, the author’s

19 Lassalvy, L. 2011.
20 Cherian, J. & Lassalvy, L.
show that a replication portfolio can be created by utilizing developed country inflation-indexed bonds.\textsuperscript{21}

\textbf{5.3 The Real Retirement Life Income Fund Calculator}

The RRI Fund Calculator is an Excel-based financial calculator developed to determine the monthly contributions required by households until retirement. In order to remove the errors associated with inappropriate assumptions, the calculator has been consciously designed in a manner that minimises ambiguity.

The RRI Fund Calculator is structured into two parts:

1. Initial Survey – asks basic demographic questions to calculate how much you would need to contribute on a monthly basis if you were to commence today.

2. Gap Analysis – asks a series of questions that allows you to tailor the monthly contributions according to your own specific requirements, including:
   - Changes to desired retirement age
   - Current money available for immediate contribution to the RRI Fund
   - Delaying or graduating monthly contributions
   - Lump sum contributions upon retirement from sources such as CPF and Equity Release from property owned.

A help section with easy links is provided within the calculator to explain the questions in more detail. This again is an attempt to reduce the risk of misinterpretation and incorrect assumptions.

The components of the calculator and their rationale are discussed below. Flow charts for the calculator can be found in Appendix A. The Excel file is available to be viewed in conjunction with this report.

5.3.1 Date of Birth and Gender: Life expectancy and Longevity risk

The key component in any retirement calculator is date of birth and gender. At its most simple level, this data informs the current age and the number of years to retirement. At a more complex level, this data is also compared against the actuarial table used to estimate the life expectancy of the individual(s).

The department of Statistics Singapore\textsuperscript{22} publishes an actuarial table for Singapore residents\textsuperscript{23}. A snapshot of the actuarial table\textsuperscript{24} is provided on the “MortalityData” worksheet of the financial engine that is built in Excel. The life expectancy (“ex”) column provides the expected life of males and females in years based on current age.

The Singapore CPF is one of the world’s largest defined contribution pension plans, and hence an annuitized model of retirement income poses longevity risk, i.e., the household outliving the planned retirement income annuity payments. Many studies are done with a\textsuperscript{22}

\textsuperscript{22} SingStat website, Key Indicator page.

\textsuperscript{23} The resident population comprises Singapore citizens and permanent residents.

\textsuperscript{24} Complete Life Table for Singapore Resident Population, 2010 (Preliminary)
focus on longevity risk and annuities\textsuperscript{25}. The government involvement in pension and retirement planning can take many forms such as Mandatory Retirement Savings, Sovereign Guaranteed Funds, tax incentives, and the issuance of consumption- or inflation-indexed bonds. Another benefit of sovereign involvement is increased participation and contribution rates that will leave pension funds exposed to only population-level longevity risk. Furthermore, sovereign involvement in mandatory and default annuitization will lower the cost as compared to one provided by private sector in terms of “Reduced Profitability Needs”, “Lower marketing, advertising and distribution costs” and “Narrow gap between premiums and anticipated benefits”\textsuperscript{26}

5.3.2 Desired Retirement Age

The desired age for retirement varies for individuals for a variety of reasons such as health, interests, and financial capabilities. Rather than assuming this age to be standard across the population, our tool allows the respondent to enter their preference within reasonable retirement age practice and laws. It allows them to alter it in order to understand what the financial implications are of earlier or later retirement. For example, the respondent might want to understand the amount of additional monthly savings he or she will require to save during the pre-retirement years if they retire at 62 rather than at 65.

Since the RRI Fund is intended as a national, sovereign guaranteed and managed retirement planning tool, it is hence practical to include some restrictions around this variable.

\textsuperscript{25} Fong, J.H.Y, Mitchell, O.S, & Koh, B.S.K.\textsuperscript{26} Fong, J.H.Y, Mitchell, O.S, & Koh, B.S.K.
Governments internationally are encouraging its citizenry to work longer as life expectancy increases and populations age. As a consequence, the RRI Fund calculator restricts desired retirement ages to a range between 62 and 67 years.

5.3.3 Current Assets Available for Contribution to the RRI Fund

Many households will have current savings or relatively liquid assets that they may be willing to contribute to the RRI Fund immediately and, in doing so, reduce their monthly contributions.

Whilst many retirement calculators look at current cash inflows and outflows to facilitate understanding current capacity for additional savings, this process involves a number of assumptions. To remove this, our survey simply asks what the amount of money that the respondent is able to deposit today into the fund. It is not concerned with where these monies come from, be they personal savings or through the sale of assets.

5.3.4 Delayed or Graduated Contribution Structure

It is recognised that households will have different capacities to contribute to the RRI Fund based on their changing circumstances as they move through the life cycle. For example, increased cash inflows from pay rises, or decreased cash outflows as expenses such as mortgages and school fees are removed, will influence the amount that a household is able to contribute. The RRI Fund calculator allows respondents to graduate their payments on a monthly basis to reflect this change in capacity.
5.3.5 Future Assets for Contribution to the RRI Fund

The two main assets for Singaporeans at retirement are their CPF funds and property owned. In 2010, home ownership in Singapore was at 87.2 per cent. These assets represent potential sources of funds which can be used as ‘top-up’ for the fund upon retirement, and hence reduce the current monthly contribution requirements.

1. CPF Contribution – upon retirement individuals can withdraw lump sums beyond that of the ‘Minimum Sum’ (refer to Section 4.0) which can be directly contributed to the RRI Fund at that point.

2. Equity Release – a relatively new facility to Singapore, the first equity release or reverse mortgage facility was introduced for private property in 1994 by NTUC Income. In 2006, the Housing Development Board (HDB) relaxed their restrictions and allowed reverse mortgages to be taken out on HDB properties. Beside NTUC Income, OCBC is the other major financial institution that provides this facility in Singapore. A lump sum contribution at retirement through an equity release mechanism can be used to reduce the monthly contributions.

5.4 Requirements for Retirement – How Much is Enough?

As previously discussed many retirement calculators rely on asking a series of questions about assets and liabilities plus a series of assumptions, including an (uncertain) investment rate of return, in order to determine a desired standard of living. This is, of course, open to

27 SingStat website, Key Indicators page
error. Furthermore, as the intent of this fund is to provide all Singaporeans with an inflation-protected, dignified standard of living in retirement for life, this type of error-fraught questioning becomes unnecessary.

The average monthly household expenditure for Singaporeans aged 65 and over presently has been taken as the proxy amount required to achieve a dignified standard of living in retirement.

To this end, the Singapore Department of Statistics conducted a Household Expenditure Survey in 2007/2008 which determined the average monthly household consumption expenditure. In this survey, household consumption expenditure was defined as “the value of consumer goods and services acquired, used or paid for by a household for the satisfaction of the needs and wants of its members” on a monthly basis.\(^29\) The average monthly expenditure per household by age group can be found in Figure 3.

<table>
<thead>
<tr>
<th>Age Group of Main Income Earner (Years)</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 25</td>
<td>25 - 29</td>
</tr>
<tr>
<td>Dollar</td>
<td></td>
</tr>
<tr>
<td>3,617.0</td>
<td>4,418.8</td>
</tr>
</tbody>
</table>

*Figure 3: Average Monthly Household Expenditure By Age Group*\(^30\)

For those aged 65 and over, the average household expenditure was $2,154.50 in 2007/2008. It was noted that this amount included $612.10 in actual and imputed amount spent on rentals for housing. Given the high rate of home ownership amongst Singaporeans...


(87.2 per cent\textsuperscript{31}), it is assumed that as of the age of 65 they would have 100% equity in their property. Hence, this amount has been removed, reducing average household expenditure to $1,542.40. This figure has been adjusted to account for inflation, providing a final figure of $1,812.15 required per household at the time of retirement. Full details regarding the derivation of these figures can be found in Appendix B.

It has been assumed that the typical household of those aged 65 and over contains two people. However, it is recognised that this will not always be the case. In some cases there will be additional generations living within the same household. However, given that the purpose of this fund is about providing a safety-net for those in retirement, younger generations and their potential contributions and expenses will not be considered here. Furthermore, it is assumed that the younger generations will be employed and hence, catering for their own expenditure.

Another alternative that is possible within this population is a single person household. It is recognised that many household expenditures exist regardless of whether there are one or two members; hence, simply reducing the required income by 50 per cent is inappropriate. To cater for this, single person households are allocated 70 per cent of the average household expenditure, or $1,268.50.

**5.5 The Financial Model**

As discussed previously, a reasonably good replication strategy can be used to replicate the inflation-indexed bond for any country. However, for simplification purpose, the calculator

\textsuperscript{31} SingStat website, Key Indicators page.
relies on the real term structure computed using US Treasury Inflation-Protected Securities (TIPS) for various maturities. The complete methodology to estimate the long-term real term structure is explained in Appendix D.

Once the real discount rates for all maturities are obtained in local currency, the model simply discounts all the real cash flows at various maturities and computes the NPV. To compute the required real monthly contributions, the model sets this computed NPV to ZERO.

The monthly savings computed by the model is a simple life annuity. In simpler terms, this is similar to households buying inflation-indexed zero coupon securities of constant maturity each month that will pay the desired real retirement monthly income each month in retirement. The nominal monthly contribution will vary based on the realized inflation rates and the real term structure at that particular point in time. The model computes such cash flows as a growing annuity and discounts the real cash flows accordingly.

6.0 RRI Fund Calculator Case Examples

Scenario I – Calculating real monthly contributions and gap analysis for the single person household

RRI Fund Calculator - initial survey prompts the user to input current age, gender, desired retirement (capped at 67) and household status in order to calculate the “Suggested real monthly contribution”. This monthly contribution would ensure an inflation-protected dignified standard of living in retirement based on the user input.
Consider a single person household of User A, male aged 29 who is willing to retire at the age of 65, whose monthly contribution would be $301.92.

Assume User A would not be able to contribute the aforementioned amount and would like to fine tune his retirement plan. The Gap Analysis calculator allows him to revise the monthly contribution by changing one or more inputs from the list below:

1) Additional upfront contribution

2) Change in the desired retirement age

3) Gradually increase in the monthly contribution

4) Contribution from current CPF retirement account

5) Equity contribution from the house at the time or retirement

For example, in case User A can only contribute $200 on a monthly basis. This would result in a shortfall of $64,006 at the time of his desired retirement age of 65.
He can close this gap by contributing $18,000 from his current savings of $50,000 and extending his retirement age till 67. This combination will result in surplus of $2,431 at the time of his retirement at age 67.
Scenario II – Calculating real monthly contributions and gap analysis for the two person household

Let’s consider a two person household comprising of User B, a female of age 30 years and her husband age 31. User B would like to retire at age 65, which would result in suggested real monthly contributions of $508.52.

As in scenario I, User B can access the Gap Analysis calculator to revise her monthly contributions. Let’s assume she does not want to change her retirement age, but is willing to contribute 40% of the equity from her $400,000 house at the time of retirement. This would allow her to lower the monthly payment to $300, and still have a surplus of $2,709 at the time of her retirement at age 65.
7.0 Limitations

There are some limitations to the RRI Fund that will need further investigation and refinement moving forward.

1. Equity Release (or Reverse mortgages):
   - Home ownership represents an important asset and potential source of funds for Singaporeans, hence we have included it. However there are a number of issues which require refinement so as to not imbed incorrect assumptions, which we have been trying to avoid in this tool.
   - It is noted that there are a number of different institutions and facilities for accessing these funds which have varying interest rates, equity requirements and payout structures. These are based not only on the property and its location but also the age of the respondent. For current purposes, we have assumed that 80 per cent of the stated marked value is available to the respondent. This is a compromise and a limitation of the calculator.
• A potential solution could be to ask people to access equity release calculators from their institutions to determine what payout they would receive. Transparency of the process and limitations on the final calculator will be paramount.

2. Delayed or graduated contributions:

• This limitation is largely one of the question’s structure. Currently the calculator asks respondents how much they can contribute now, and how much they can commit to increase by on a monthly basis. This is not particularly intuitive or reflective of reality where people are more likely to think about increases on an annual basis.

• A potential solution would be to change the question to an annual increase rather than monthly, however further refinement of the question and financial model would be required to manage the impact of inflation over that time period.

8.0 Moving Forward

The purpose of the project was to synthesise various studies done in the field of retirement investing and suggest a simplified and most prudent model which captures the best of all studies and applies them in emerging economies scenario. Although many such retirement planning calculators exist, they lack in terms of underestimating the inflation and credit risk.

The main focus while developing the framework was to address these two risks in the context of real challenges faced by households in these countries.
Going forward, the aim is to increase the financial literacy of households who will probably need such retirement planning tools the most. Hence, it is envisioned that utilizing the basic framework developed, a team can take it to the masses by harnessing the power of technology. Specifically, the idea is to develop an online (web-enabled) retirement financial calculator which can be used by households to ascertain retirement savings that will be required to get assured real income in retirement to provide a dignified standard of living.

The supplementary aim is to promote sovereigns and other governmental agencies such as the CPF to start addressing the issue by including such retirement investment schemes within the framework of other regular pension schemes.

Specifically, within the Singaporean context, this will require the following tasks:

1. Development of an inflation protection replication strategy for Singapore. The current financial model uses the real term structure obtained from US Treasury TIPS, however a more robust Singapore inflation replication strategy is required.

2. Validation of the appropriate amount required per household for a dignified standard of living.

3. Refinement of the RRI Fund Calculator to minimise the ambiguities and the development of an online calculator tool.

4. Engagement of the CPF agency to determine how this fund can be embedded within the current retirement investment scheme to ensure a dignified standard of living for all Singaporeans.
9.0 References


CPF website, Overview page, viewed online on 12/11/11 at: http://mycpf.cpf.gov.sg/CPF/About-Us/Intro/Intro.htm

CPF website, Interest Rate page, viewed online on 12/11/11 at: http://mycpf.cpf.gov.sg/NR/rdonlyres/5C7AAE66-A2F1-4DCD-9898-D6D1F37A8FB0/0/InterestRate.pdf


SingStat website, Key Indicators page, viewed online on 12/11/11 at:


SingStat website, CPI page viewed online on 20/11/11 at:

Trading Economics website viewed online on 20/11/11 at:
http://www.tradingeconomics.com/singapore/inflation-cpi

US Department of Treasury website, Daily Treasure Yield Curve page, viewed online on 20/11/11 at:
10.0 Appendices

10.1 Appendix A: Flow Chart of the RRI Fund Calculator
Real Retirement Income Fund

Initial Survey

Enter your current age

Enter your gender

Enter desired retirement age

Enter your marital status

Married/Separate

Enter spouse's income

Single

Enter your marital status

Click on Calculate

Estimated monthly contributions

Click on the age you expect to retire

Yes

Gap Analysis

No

End
10.2 Appendix B: Derivation of the Minimum Income Requirements for Retirement

To answer this issue the various aspects such as prevailing inflation rate, consumer price index (CPI), and demographic data were taken into consideration. Inflation rate is on the rise again and currently sits at 5.5% (Sept 2011\textsuperscript{32}) which is 2.77% higher than the historical average (from 1962 to 2010\textsuperscript{33}). The data provided by the Department of Statistics, Singapore on CPI was analysed to understand the composition of the index and relative changes in the prices. Table 1 shows the composition of the basket (with 2009 as base year) and the relative changes in year 2010 and 2011. Housing and transportation prices were observed to be the main drivers in raising the CPI levels.

<table>
<thead>
<tr>
<th>CPI Basket Items</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Base Year</td>
<td>Year on Year</td>
<td>Year on Year</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Feb 2010/Feb 2009)</td>
<td>(Feb 2011/Feb 2010)</td>
</tr>
<tr>
<td>Food</td>
<td>22%</td>
<td>1.20%</td>
<td>2.60%</td>
</tr>
<tr>
<td>Clothing and Footware</td>
<td>3%</td>
<td>-1.30%</td>
<td>1.30%</td>
</tr>
<tr>
<td>Housing</td>
<td>25%</td>
<td>-2%</td>
<td>5.80%</td>
</tr>
<tr>
<td>Transportation</td>
<td>16%</td>
<td>7.60%</td>
<td>15.20%</td>
</tr>
<tr>
<td>Communication</td>
<td>5%</td>
<td>-2.10%</td>
<td>-1.70%</td>
</tr>
<tr>
<td>Education and Stationary</td>
<td>7%</td>
<td>2.20%</td>
<td>3.30%</td>
</tr>
<tr>
<td>Healthcare</td>
<td>6%</td>
<td>0.70%</td>
<td>3.20%</td>
</tr>
<tr>
<td>Recreation and others</td>
<td>16%</td>
<td>0.20%</td>
<td>0.80%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\textit{Table 1: CPI Composition 2009-2011}\textsuperscript{34,35}

\textsuperscript{32} http://www.tradingeconomics.com/singapore/inflation-cpi

\textsuperscript{33} ibid

\textsuperscript{34} SingStat, 2010.
\textsuperscript{35} SingStat, 2011.
Also discussed in Section 5.4 the data derived from the Household Expenditure Survey completed in by the Singapore Department of Statistics in 2007/2008 was used as a proxy for the minimum requirements for retirement. Once the value allocated for imputed rentals were removed based on the assumption of 100% equity in property by the age of 65, the average household expenditure for those aged 65 and over was determined to be $1542.40 in 2007. In order to bring this number to 2011 levels, 2009 was taken as the base year (100%36) and adjusted according to the CPI levels of 2011 (109.537) and 2007 (93.2%38). As a result one would need $1812.15 at time of retirement. Table 2 details these calculations.

| Average household expenditure Excluding ($612.1 in actual and imputed rentals for housing) (for 65 and above*2007 data) | $ 1,542.40 |
| Base year 2009 | 100 |
| CPI 2011 | 109.5 |
| CPI 2007 | 93.2 |
| Rate (CPI 2011/CPI 2007) | 1.1748927 |
| Average household expenditure Excluding actual and imputed rentals for housing (for 65 and above*2011 data) | $ 1,812.15 |

*Table 2: Adjustment of 2007 Average Household Expenditure to 2011 Levels*

**10.3 Appendix C: Methodology For Development of Real Term Structure**

**TIPS:** Treasury Inflation-Protected Security

The US Treasury issues inflation indexed securities and following are the key characteristics.

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36 SingStat website, CPI page.
37 SingStat, 2011.
38 SingStat website, CPI page.
**Inflation Index:** The US CPI (Urban) is used to index the TIPS coupon and principal payment. Suppose value of CPI at issue was CPI₀ and value of the same at any time t is CPIₜ – we can define an inflation Index I(0,t) as mentioned below.

\[
I(0,t) = \frac{CPIₜ}{CPI₀}
\]

**The Indexation Lag:** Although TIPS are designed in such a way that they provide protection against inflation (as measured by CPI-U), however, because of the lack of data CPI-U published 3 months before the settlement date or maturity date is used in the calculations. In the long term – as is the case in our project – this effect has negligible impact.

**Real Accrued Interest:** The real accrued interest (Based on settlement date and coupon date) is calculated as for nominal Treasury bond:

\[
AIₗ = \frac{\#OfDaysSineLastCoupon}{\#OfDaysInTheCouponPeriod} \times CouponRate
\]

**Quoted or Clean Price:** The clean price does not include accrued interest and the inflation adjustments.

**Invoice or Dirty Price:** The dirty price is obtained from the clean price by accounting for accrued interest and inflation.

\[
DirtyPrice = (CleanPrice + AIₗ) \times I(0,t)
\]
**The PUT Option:** The embedded PUT option in treasury TIPS ensures that principal payment at maturity is not below $100 in nominal terms. The principal payment at maturity T can be described using following notation:

\[ \text{Principal Payment} = \text{Max}(100, 100 \times I(0, T)) \]

**Inflation Seasonality:** The seasonal nature of inflation is well documented in OECD countries and elsewhere and it can impact the price of TIPS from period to period.

**Model Assumptions:** Hence the real yield obtained from TIPS can be used as good proxy for real rate of interest. We are assuming that the value of embedded put option (Value assumed to be zero i.e. no deflationary scenario) and CPI-U lag is not going to significantly impact the model calculations. Furthermore, the par real yield i.e. a hypothetical TIPS that has a coupon rate of exactly the real yield for that maturity will always sell for $100. Thus to construct the Real Term Structure we can safely discount the real cash flows (Non-inflation adjusted cash flows i.e. not assuming the impact of I (0, t)) with the applicable zero-coupon discount rates. This method is described in the section below. Another notable aspect is that a freshly-issued TIPS will have no accrued interest and will have no inflation component while computing. Similarly the clean price of a TIPS that has no real accrued interest (and clean real yield) will have a dirty price that will exactly account for inflation till the settlement date i.e. Dirty Price = Clean Price \times I(0,t). If an investor purchases such a TIPS and holds it for maturity, at maturity T she will receive Max (100,100 \times I(0, T)). Assuming positive inflation, this will be equal to 100 \times I(0, T) or 100 \times I(0, t) \times I(t, T). Which is same as the Dirty_Pricet \times I(t, T) i.e. Real $100t i.e. the real cash flows are not impacted by prevalent inflation.
**Par Real Yield Curve:**

We obtained Treasury Real Yield Curve Rates (Real Constant Maturity Treasury – R-CMTs) from the US Treasury website\(^{39}\) for maturities of 5 years, 7 years, 10 years, 20 years and 30 years. Using the assumption of real long term yield (for maturity 70 years) of 1.9\(^{40}\) in OECD countries, we used the cubic spline interpolation technique to obtain the Par Real Yield Curve.

**Smoothing:** The market price of TIPS and real yields tend to be a lot volatile – especially towards the shorter end of the yield curve. However, for long term retirement planning this volatility of real yields is undesirable because the individual saving pattern cannot be altered and adjusted as quickly. Hence, it was decided to smooth the curve to reduce the impact of volatility. A rolling window of 180 days was used to compute the moving average for each of the various maturity TIPS.

**Real Rate Term Structure:**

The Par Real Yield Curve was utilized to obtain the real rate term structure. Based on the assumption and TIPS characteristics described previously, following steps were followed.

Step1: The real yields on various TIPS maturities. This was the primary data we obtained from the Par Real yield curve.

Step2: The Price Matrix (\(P\)). If TIPS for all the required maturities were available, this is the price of each of these TIPS. The current price i.e. the discounted real cash flows using par  

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\(^{39}\)US Department of Treasury website, Daily Treasure Yield Curve page  
^{40}Barrie & Hibbert. 2008.
real yield of a TIPS bond (paying real $100 at maturity and coupons in between) will be exactly $100.00 today.

Step3: Real Cash Flow Matrix (A): The real cash flow for each of these various TIPS till maturity was obtained using the par real yield.

Step4: We used the “MINVERSE” excel function to obtain the inverse of real cash flow matrix (A⁻¹).

Step5: The Zero Coupon Bond Price Matrix (Z): Using the following matrix formula the prices of ZC TIPS of various maturities was obtained. These are the real discount factor that will be used to discount real cash flows.

\[ Z = A^{-1} \times P \]

Step6: The spot real rate for various maturities (For Real Term Structure) was computed using the formula mention below. B (0, n) (Obtained from Z matrix) is the price of the bond today which pays exactly real $1 at maturity in n years. \( r_n \) is the spot real rate for maturity n. We have consistently used the semi-annual compounding as is the norm in the TIPS bond pricing.

\[ B(0,n) = \frac{1}{\left(1+\frac{r_n}{2}\right)^{n\times2}} \]