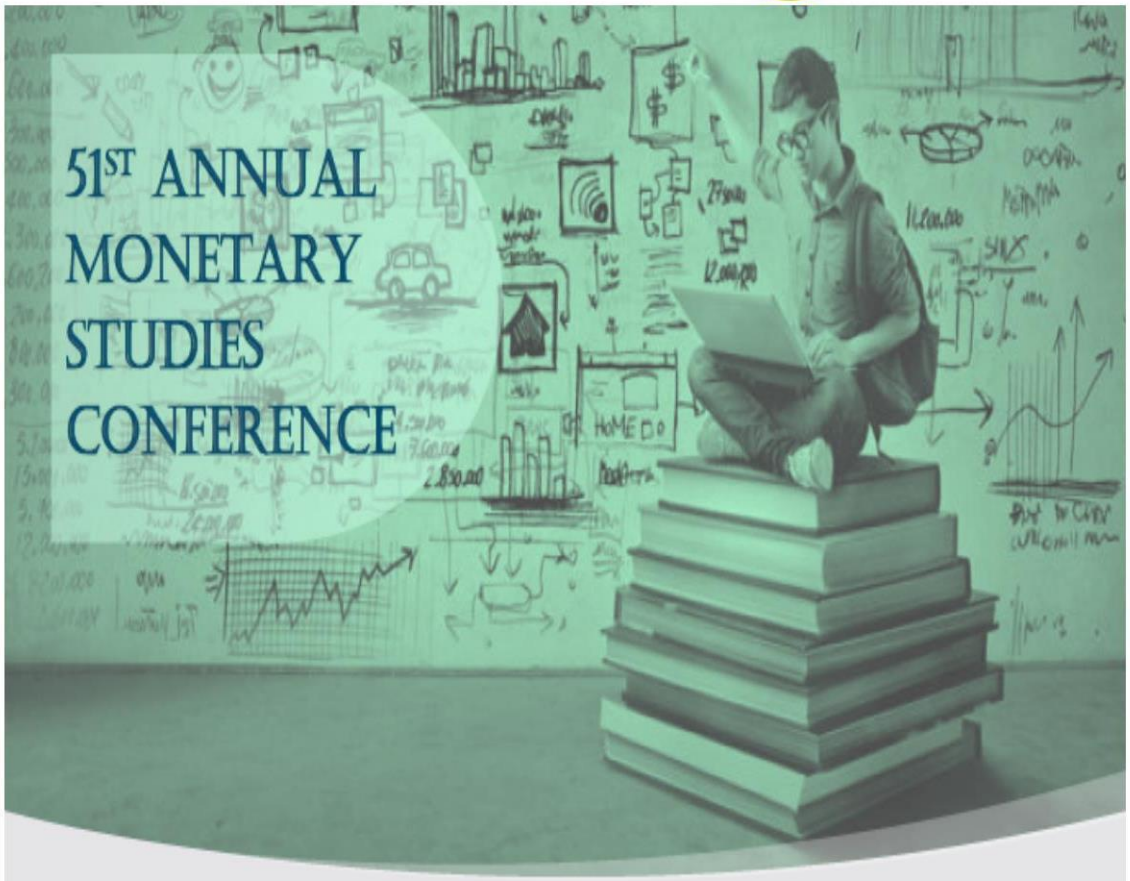
Caribbean Economic Research Team



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Too Small to Fail: An Analysis of the Potential Use of Public and Private Insurance to Recover from Natural Disasters in the Caribbean

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Abstract

Hurricanes pose a significant challenge to both the public and private sectors in The Bahamas, and the wider Caribbean, accounting for an estimated US$450.9 billion[1] in damages throughout the region over the last ten years. As a result of climate change, it is expected that the social and economic costs of these natural disasters will only be intensified over the near to medium term. Given the billions of dollars of losses that the Caribbean incurs each year, this paper therefore seeks to investigate an alternative approach to mitigating the financial burden from the damages on a small open economy such as The Bahamas, following a catastrophic hurricane. Using a modified household life-cycle consumption-saving model, the study attempts to determine whether public pension funds can be deployed to effectively smooth the welfare effects on households over time. Our findings reveal that a withdrawal allowance can potentially mitigate the adverse effects of hurricane shocks on household consumption paths in the years following a disaster. Of the three hypothetical simulations assessed, the allowance rate of 30% proved to be the optimal choice with the least amount of financial constraints for pensioners over the long term.

[1] Based on the authors' estimate of financial damages over the ten years period 2007-2017.

1. Introduction

The Bahamas is comprised of 700 islands and cays, of which approximately 20 islands have significant population levels. The country's geographical location within the "hurricane belt" makes it susceptible to the annual threats of catastrophic hurricanes. Over the last decade, the archipelago has incurred accumulated damages in excess of US $1.6 billion[2], due to the adverse effects of powerful storms such as Hurricanes Sandy (2012), Joaquin (2015), Matthew (2016) and Irma (2017) on several of the major population centres.

Traditionally, foreign reinsurance inflows have assisted in mitigating the impact of the damages on properties that are covered by hurricane insurance[3]; however, the percentage of properties which are eligible to receive these payments outside of the capital city of Nassau, has tended to be low. Consequently, the Government is typically left with the task of repairing damaged infrastructure, as well as reconstructing and fixing uninsured homes, which have been affected by these storms. Funding for the rebuilding effort is typically sourced from a combination of internal and external borrowings, including a $150 million syndicated loan from several commercial banks, which was obtained in 2016 to support recovery efforts after Hurricane Mathew. More recently, the Government attained a $100 million contingency loan from the Inter-American Development Bank (IDB) in 2018, to assist with its future hurricane rebuilding needs. In addition, The Bahamas currently maintains a parametric insurance plan with the Caribbean Catastrophic Risk Insurance Facility SPC (CCRIF SPC), which allows the Government to make claims based on catastrophic damage to each of its three regions.[4] Despite having this coverage, past payouts from the CCRIF SPC have proven to be insignificant in helping the country recover from natural disasters, as its most recent claim of $234,000 following Hurricane Irma in 2017, accounted for less than 1% of the estimated value of the total damages.

At the micro level, households are also saddled with the burden of extensive repair bills, forcing them to either leave the property in a derelict condition or to seek Government assistance with their rebuilding efforts. When the average citizen's high debt burden is paired with the prohibitive costs of insurance plans, and the lack of compliance with out-dated building codes[5], then it comes as no surprise that the homeowner's insurance market remains drastically underutilized. There are currently more than 60% of Bahamian households, which are either without insurance or are underinsured[6], and as result of the increase in the value

[2] Based on reported estimates of damages from the named storms.

[3] In 2016, reinsurance inflows following Hurricane Mathew totaled approximately $409 million.

[4] In May 2018, The Bahamian government negotiated with the CCRIF SPC for the islands to be divided into three zones instead of one jurisdiction to allow more fair assessments and payouts after catastrophes.

[5] As of August 1, 2018, over 150 families resided in the 11 shantytowns across New Providence alone, where land is leased for farming purposes only, however; the living structures that are built are usually inadequate to provide protection during severe weather.

[6] In its 2017 Article IV consultation, the International Monetary Fund (IMF) provided this estimate, while urging The Bahamas to increase insured assets considering the heightened hurricane risks.

added tax (VAT) rate on July 1st 2018, the homeowner's premium charges[7] could increase further, resulting potentially in more households opting to reduce their level of coverage.

As the potential damages from hurricanes trend upwards in response to global climate change, so does the risk to the economy from severe storms. With an economy that depends primarily on tourism, a lack of resources and funding after catastrophic disasters, can have serious implications for both the large hotel and private rental markets, as well as other small businesses that depend on visitor activity. The local economy may also experience negative shocks, as households scale-back on consumer spending to better assist their recovery efforts, while potential job losses arising from the damage caused to vital tourism infrastructure, could exacerbate this problem.

This paper therefore aims to investigate the potential for households to deploy assets accumulated in private and public pension accounts to fund disaster relief efforts. It utilises a life cycle savings model to analyze the likely effects of their early withdrawal on mitigating the financial challenges faced by households after hurricanes in The Bahamas, thereby reducing the need for consumers to either attempt to secure Government funding or to cut back on demand after catastrophic disasters. To the authors' knowledge, this is the first of this type of research conducted for the Caribbean.

The remainder of the study is therefore organised as follows: section 2 provides an overview of the structure of pension plans in the Caribbean; section 3 outlines the key studies which have been conducted on the use of pension funds to recover from natural disasters globally, as well as some of the main research conducted using life-cycle savings models. The following section presents the model utilised to determine whether The Bahamas—as a proxy for the Caribbean—is a suitable candidate for this type of hurricane relief financing. Section 5 presents the results for the baseline model, while the final section concludes the study and provides some areas for possible future research.

2. Overview of Pension Arrangements in the Caribbean

With a mission to assist the social and infrastructural development of the country, the National Insurance Board (NIB) administers The Bahamas' social security programme. NIB receives compulsory defined contributions on a monthly basis from gross earnings that are then utilized for investments. In 2016, the fund recorded total assets of US$1,789.0 million, a loss of 1.1% in comparison to the prior year, while contribution income fell by 0.9%—the largest decrease since 2008—due to the sluggish growth rate of the Bahamian economy, as well as the impact of Hurricane Matthew in the latter half of the year. Benefit payouts continued their upward trajectory, amid the aging of the Bahamian population and the biennial cost of living adjustments, which led to pension payments increasing by 3.1% in July 2016. Table 1 (Appendix) summarizes the Board's latest performance indicators.

[7] Residential property insurance was made VAT exempt and not "zero rated", meaning the 4.5% increase could possibly affect consumers, as insurance providers will still have to pay those taxes on its input costs, therefore passing the expense onto consumers by way of increased prices.

The Board provides benefits to insured persons who meet specific contribution conditions relevant to unemployment, maternity, invalidity, survivorship, sickness, injury, disablement, funeral and death. Cash assistances, such as old age non-contributory pension, invalidity, survivors' and sickness, are also provided to needy Bahamian residents who do not qualify for a particular benefit. Table 2 (Appendix) summarizes the benefits and assistance offered by NIB in 2016.

Private sector pension plans fall into various categories, such as: defined benefit, defined contribution, and provident or hybrid funds. Under the defined contribution plan, employees allot a fixed rate of gross earnings, which is matched by employers to a specific percentage, into a retirement fund, which is utilized for investments. Such plans usually contain restrictions as to how and when employees can obtain funds, oftentimes after a prolonged period of employment or at retirement age. According to the Private Pension Survey conducted by the Central Bank of The Bahamas in 2016/17[8], private pension assets stood at approximately US$1,172.70 million or 9.7% of GDP at year-end 2017, with 52,363 participants or 25.7% of the workforce, deriving mostly from the tourism industry, followed by the communications and utilities, financial, and transportation sectors. Throughout the region, public pension schemes are in some respects similar to the NIB in The Bahamas, with Barbados, Trinidad and Tobago, and Jamaica all utilizing compulsory earnings-related defined benefit programmes. Providers distribute old age pension payouts as well as settlements for unqualified contributors; however, public pension contribution rates vary. Pension funds are accessible at specified retirement age, with strict criteria attached if accessed earlier. Selected regional national insurance plans are compared in Table 3 of the Appendix.

To the best of the authors' knowledge, there exists no early withdrawal policy for disaster relief within the region. Indeed in the Western hemisphere, one of the few recent examples of the early withdrawal of pension funds after a catastrophic natural event, occurred in the United States after the severe flooding in the state of Louisiana in 2016. Following this disaster, the Internal Revenue Service (IRS) allowed victims to receive loans (up to a specified statutory limit) and hardship distributions from their 401(k)[9] and employer sponsored retirement plans, with relaxed procedural and administrative rules, allowing for quicker disbursal of funds. The withdrawals are taxed at 10%, while loan proceeds have the possibility of remaining tax-free, if repaid within five years[10].

3. Overview of Literature

[8] The survey was sent to approximately existing and potential pension plan sponsors in The Bahamas. 39 of surveyed companies responded (35.0%). All large companies' surveys were submitted and compilers generated estimates for smaller companies that failed to respond.

[9] A 401(k) is a defined contribution retirement saving plan sponsored by an employer that allows workers to save and invest a portion of their paychecks before taxes are taken out.

[10] See:https://www.shrm.org/resourcesandtools/hr-topics/benefits/pages/401k-withdrawals-louisiana-flood.aspx, for a detailed analysis of the measures taken by the US Government in response to the flooding in Louisiana.

The research relating to the utilisation of public/private pension plans to provide short-term funding for households after a natural disaster is limited. Nevertheless, those which are relevant include Auffret (2003), who evaluated empirically testable inferences that explained the impact of the high volatility of consumption, stemming from shocks caused by catastrophic disasters on household welfare in the Caribbean region. The study revealed that consumption volatility can be expected to be larger in countries with less developed financial and risk management mechanisms, with production volatility playing a major role in consumption volatility. The authors also found that if counter-cyclical policies effectively reduce consumption volatility, then private consumption volatility can be expected to be higher than that of total consumption. As it relates to either reducing or smoothing total consumption volatility, the author noted that governments are able to play a positive role by providing more public goods during periods of low private consumption. The impact of disasters was also estimated using a dynamic panel data model based on generalized methods of moments (GMM), and showed that catastrophic events lead to a slowdown in output, consumption and investment growth, with the greatest impact falling on investment gains and to a lesser extent on total consumption growth.

Against the backdrop of an *a priori* assumption that the private sector could not adequately assist the poor with safety measures for climate change risks, Linnerooth-Bayer et al (2009), examined the benefits, costs and risks of public and private insurance programmes that offer inexpensive security to vulnerable parties, in addition to the inclusion of insurance and risk transfer instruments in a climate adaptation strategy. The team also elaborated on the insurance pillar proposal of the Munich Climate Insurance Initiative (MCII), which is a part of a greater climate risk management approach that is geared towards absorbing high level risk and allowing specific insurance systems to take care of middle layer risks. The writers concluded that including insurance solutions in the adaptation strategy, would be extremely useful in mitigating economic and social damages after weather-related disasters, as it encourages sustainable, affordable and incentive-compatible programmes, without congesting the private sector market.

Winter, Schlafmann and Rodepeter (2012), sought to determine the utility loss households face when they utilize either simple or sophisticated decisions rules, or rules of thumb, to make savings and investment decisions. In this regard, the authors employed a standard life cycle model with borrowing constraints and life time and income uncertainty. The authors computed utility losses relative to three alternate rules of thumb, namely: consumption equals income; consumption equals permanent income; and consumption equals cash on hand up to mean income, plus 30% of excess income. It was discovered that utility losses across various environments as a result of some simple rules of thumb were relatively low, between 5% and 10% of life time income. The authors discussed extending the research further by combining simple decision rules with different objectives, as well as comparing the welfare outcomes of sub-optimal savings decisions with suboptimal portfolio choices, when both are driven by rules of thumb.

In addition, Guo and Narita (2018), utilized a life cycle saving model with myopic households facing large natural disaster shocks, to analyze the use of early public pension

withdrawals after disasters in the Pacific island countries. The authors stated that this policy ultimately helps households finance their expenses after natural disasters, which could lead to an improvement in overall welfare, as the need for supplementary savings is reduced. However, they highlighted that continued use of this policy would require an increase in the mandatory contribution rate to offset households' urge to decrease their non-pension savings, due to the security of the early withdrawal scheme. In addition, the policy has the potential to negatively impact financial stability, as the authors noted that in Fiji, one commercial bank's deposits declined severely after early withdrawals, and resulted in a liquidity shortage for the bank.

4. Methodology

Given the similarities between the Pacific Island countries and The Bahamas as it relates to risks of natural disasters (specifically hurricanes), GDP composition, high levels of underinsurance and mandatory fixed pension schemes, it was determined that it would be appropriate to adopt a modified version of the household life-cycle consumption-saving model, utilised by Guo and Narita (2018), to analyze the effects on household consumption paths and welfare following a natural disaster shock to The Bahamas.

In order to effectively utilise the model, a finite period discrete-time household problem, with income shocks that capture large and unpredictable natural disaster shocks, was set-up where: each person works for K periods, retires at age K+1 and lives up to age T at maximum. Labour income y_w is assumed constant when no natural disaster occurs; a basic substance income y_r, that is independent of natural disaster shocks, is received after retirement; income loss D_c occurs following a natural disaster; natural disasters occur with probability p and no predictability; households face a true value survival rate of P_s, which is higher than households' belief of P_s^H; employees and employers contribute a fixed pension rate τ until the retirement age; and withdrawal assistance Δ is available following qualifying natural disasters. Moreover, a zero borrowing constraint is put in place for households, in addition to them making savings for retirement and self-insurance against natural disaster shocks. Assumed parameter values and underlying explanations are shown in Table 4 (Appendix), with one model period remaining equivalent to 2 years and life time starting at 20 years old.

The model analyses the current pension scheme that does not allow for early withdrawals, as well as hypothetical scenarios where withdrawals of 30%, 50% and 60% of pension balances are allowed, and replenishment of withdrawn amounts are not required. It is solved numerically by value function iteration combined with backwards induction via MATLAB® using modified codes adopted from Winter et al. The effects of unexpected one-off withdrawals are examined by simulating the consumption path under the assumption that the mandatory saving requirement will be lowered by Δ from the disaster year and subsequent assistance. Welfare is also compared and examined through combining non-random and simulation based numerical integrations for select parts of the histories, that produce the

expected lifetime utility of households, while mitigating the computational challenge of handling approximately 134 million ($2^T = 2^{27}$) histories in the parametrization and improving accuracy[11].

Welfare is then plotted against mandatory pension contribution rates, with τ^* signifying the optimal pension rate that will provide the highest welfare level in the event of no withdrawals allowed and τ^{**} signifying the optimal pension rate in the event of multiple withdrawals allowed.

5. Results

The results show that a one-off withdrawal allowance aids in consumption smoothing during the periods immediately following a natural disaster shock. In addition, welfare appears to be higher in scenarios where recurrent withdrawals are allowed.

Three separate simulations were conducted to accommodate hypothetical withdrawal allowances of 30%, 50%, and 60%. In the first scenario, the 30% withdrawal allowance demonstrated the largest net positive welfare gain, as the advances from consumption smoothing at the time of the natural disaster outweighed the losses of lower retirement consumption (Figure 1). The optimal pension rate in a state of no withdrawal allowance stood at 12%, while the optimal rate in the event of a withdrawal allowance stood at 15% (Figure 2).

In the second scenario, the simulation was executed using a withdrawal allowance of 50% which, similar to the first scenario, demonstrated a net positive welfare gain as a result of consumption smoothing outweighing the reduction in retirement spending (Figure 3). However, the gain was not as substantial as in the first scenario. The optimal pension rate in the absence of a withdrawal scheme remained stable at 12%, while the rate rose to 24% should the withdrawal allowance scheme become active (Figure 4).

In the third scenario, a 60% withdrawal allowance was applied, whereas the gains from consumption smoothing equalled the cutbacks in lower retirement consumption (Figure 5). Again, the optimal pension rate in the absence of self-insurance assistance remained at 12%, while the optimal rate in the event of withdrawal assistance came in at 18% (Figure 6).

6 Conclusions

Based on the results, it appears that household consumption following a disaster shock when pension withdrawals are allowed, appear to lead to an improved overall outcome in every hypothetical simulation. With access to what would have been illiquid savings, the economy faces less of a shock than it would have if such allowances were prohibited. However, it is

[11] See Guo and Narita (2018) for a detailed description of the combined procedure in its entirety.

important to note that this benefit comes with an expected trade-off: less money to fuel consumption during the later years leading up to and after retirement. In every scenario, once consumption is initially smoothed after the disaster, the consumption paths where withdrawals are allowed, appear to drop lower than that of the consumption paths where no withdrawals are allowed. This seems rational as the funds used immediately after the disaster shock would no longer be available for consumption in the future, as replenishment of withdrawn amounts would not be required.

Of the three hypothetical scenarios, the withdrawal allowance of 30% demonstrated the least amount of financial constraint over the long-term. Moreover, allowances in excess of 50% might have adverse effects on the economy, as welfare gains due to one-off withdrawals were negative in the simulation conducted with a 60% allowance rate. This may be attributed to large amounts of contributions being withdrawn after disasters, resulting in insufficient time occurring to replenish pension accounts closer to pre-withdrawal levels. Consequently, pensioners may receive significantly less money during retirement, and find it difficult to sustain regular consumption habits.

The simulation showed that if recurring pension withdrawals are allowed, the optimal pension rate would be notably higher than NIB's current mandatory rate of 9.8%. While this is expected, rates of 15%, 18%, or 24% may discourage employees from maintaining private pension plans, and make workers more dependent on reduced NIB payouts during their retirement. In addition, employers may develop a more conservative approach to hiring additional and sustaining existing staff compliments, as a result of the increase in pension contribution expenses. Should the aforesaid escalate, NIB could be faced with an increase in the demand for benefits by unemployed persons, while the Government might have to accommodate citizens with additional public benefits.

The study is not without its limitations. Although most parameter values were derived from credible sources, a few were estimated based on the authors' assumptions. As an example, neither the true value of a household's income loss nor the survival probability following a disaster in The Bahamas is known. While survival rates were assumed from Guo and Narita (2018), the income loss value was loosely quantified as no averaged estimates on a national level exist. Therefore, there is a possibility that the welfare levels and shocks to consumption paths can be either over or under-estimated. Additionally, the model used assigns one period to two years which implies that a disaster hits the country consecutively over a two year span. Although The Bahamas has experienced back to back disasters, our simulation would assume a loss of approximately 120% of household income over a 2-year period, which can also be either over or under stated. Further, the model can be improved to allow disaster shocks to be continuous over the course of a given lifetime, instead of one single shock, as most Caribbean residents usually experience numerous hurricanes prior to reaching retirement age.

Further studies into the survival rate of residents, as well as an appropriate average of household income losses following hurricanes can reduce the need for authors' estimates of these specific parameters, and improve the accuracy of household consumption paths and potential welfare levels. However, it is important to note that variations in factors such as

construction techniques, real estate value, pre-disaster savings, and insurance coverage etc. make these values, on a national level, extremely difficult to calibrate.

While this study utilized The Bahamas' flat rate public pension programme to assess the possibility of using contributions for disaster relief efforts, another potential funding source can be evaluated by incorporating existing private pension plans, whose contribution rates vary for individuals and corporations, into the model. Further analysis into the possible effects of early withdrawals on current pension investments and banking sector liquidity balances would also be advantageous. Also, the effects of raising mandatory contribution rates to optimal levels given by the model on private sector labour demand and unemployment levels can be analyzed to indicate if these factors have material effects on welfare and household consumption.

Appendix

Table 1. NIB Performance Indicators			
	2016	**2015**	**Change**
Total Net Contribution Income	258.1 m	260.5 m	-0.9%
Benefits Expenditure	271.5 m	258.8 m	4.9%
Yield on Investments	3.1%	4.0%	-23.0%
# of Contributing Employers	12,521	13,472	-7.1%
# of Contributing Self-Employed Persons	9,631	10,339	-6.8%
# of Active Employees (Estimate)	143,000	145,000	-1.4%
# of Short-term Benefit Claims Awarded	24,780	29,994	-17.4%
# of Long-term Benefit Claims Awarded	3,385	2,913	16.2%
# of Contributory Pensioners (at year-end)	32,311	30,792	4.9%
# of Assistance Pensioners (at year-end)	4,578	4,713	-2.9%
Source: NIB Annual Report 2016			

Table 2. NIB Benefits and Assistance (Year End 2016)		
Title	**Description**	**Payments (BSD$ '000)**
Retirement Benefit	Monthly payment made to insured persons who have retired from gainful employment or who have attained age 65 years. Persons have the option of receiving the benefit from as early as 60 years but with a reduced rate.	24,465
Invalidity Benefit	Monthly payment made to eligible insured persons who have been medically certified permanently unable to work because of illness.	2,766
Survivors' Benefit	Monthly payment made to the dependent survivors of a deceased insured person.	5,080
Old Age Non-Contributory Pension	Monthly payment to needy Bahamian residents over 65 years, who do not meet the contribution conditions for Retirement Benefit.	1,638
Invalidity Assistance	Monthly payment made to an individual who has been certified by a medical practitioner to be permanently incapable of work due to illness.	2,658
Survivors' Assistance	Monthly payment made to the needy surviving dependents of an uninsured deceased breadwinner.	282
Sickness Benefit	Weekly payment made to eligible insured persons while they are temporarily unable to work due to illness.	10,392
Funeral Benefit	One-time payment made to the person who has paid or is responsible for the funeral expenses of a deceased insured person.	2,917
Maternity Benefit	Weekly payment made to eligible insured women while at home during late pregnancy and confinement.	6,860
Maternity Grant	One-time payment made to a woman whose pregnancy results in the birth of a live infant; it is paid for each live infant.	2,415
Unemployment Benefit	Weekly payment made to eligible insured persons who are unemployed but actively looking for employment.	12,592
Injury Benefit	Weekly payment made to an employed person, or a self-employed person in Class "B", who suffers a job-related injury or contracts a job-related disease, and because of that injury or disease, is unable to work.	929
Death Benefit	One-time cash payment that is paid to the dependents of a worker who died because of a job-related accident or illness.	47
Sickness Assistance	Weekly benefit paid to an individual who is temporarily unable to work due to illness; and has paid at least one contribution, but not enough to qualify for Sickness Benefit.	1
Sources: NIB Website, NIB Annual Report 2016		

Table 3. Regional National Insurance Plans Comparison

Country	Contribution Rates	Contribution Income	Retirement Age
Bahamas	3.9% – Employee 2.0% – Summer Employee 5.9% – Employer 5.0% – Voluntary Employee 8.8% – Self Employed	BSD$258.1 million* (2016)	65
Barbados	10.1% – Priv. Sec. Employee 11.25% – Priv. Sec. Employer 8.8% – Gov. Perm. Employee 8.95% – Gov. Perm. Employer 10.1% – Gov. Temp. Employee 10.25% – Gov. Temp. Employer 16.1% – Self Employed 10.3% – Voluntary Employee	BD$532.1 million (2014)	67
Jamaica	2.5% – Employee 2.5% – Employer	J$1,480.0 million (2017)	60
Trinidad & Tobago	4.4% – Employee 8.8% – Employer 11.4% – Voluntary Employee	TT$4,608.2 million* (2017)	60

Sources: NIB Bahamas website, NIB Bahamas Annual Report 2016, NIS Barbados website, Barbados Insurance Report 2014, MLSS Jamaica website, Jamaica Insurance Report 2016, NIB Trinidad and Tobago website, Trinidad & Tobago Report On Operations 2017.
**Net Contribution*

Table 4. Parameters

Parameter	Value	Definition
t	2 years	One period in the model
T	27 (= 54 years)[12]	Number of periods in lifetime
K	20(= 40 years)[13]	Number of working periods
β	$0.96(\simeq 0.98^2)$	Household's time discount factor
γ	2	CRRA coefficient of the utility function
y_w	2 (= 1 for one year)	One period income flow when working
y_r	0.8 (= 0.4 for one year)	One period income flow after retirement
D_c	-1.0 (50% labour income loss per annum)	Income loss due to natural disaster
P	~54%[14]	One period probability of a natural disaster
P_s	0.98 ($\simeq$ 0.99 for one year)	True one-period survival probability
P_s^H	0.75 ($\simeq$ 0.86 for one year)	Subjective one period survival probability
τ	9.8% of labour income	Mandatory pension contribution rate
Δ	30%, 50%, 60%	The size of each withdrawal assistance

[12] The World Bank's most recent life expectancy for The Bahamas is 75.68 years. We keep our estimate as close as possible with 74 total years, while keeping the number of simulations manageable by keeping the figure to 76 years.

[13] Employees become eligible for pension payouts from NIB at 60 years old, and early retirement is now becoming increasingly common, with fewer employees waiting until 65 for full payouts.

[14] This assumption was derived from Colorado State University's 2016 and 2017 Tropical Meteorology Project Forecasts of 31% and 34%, respectively.

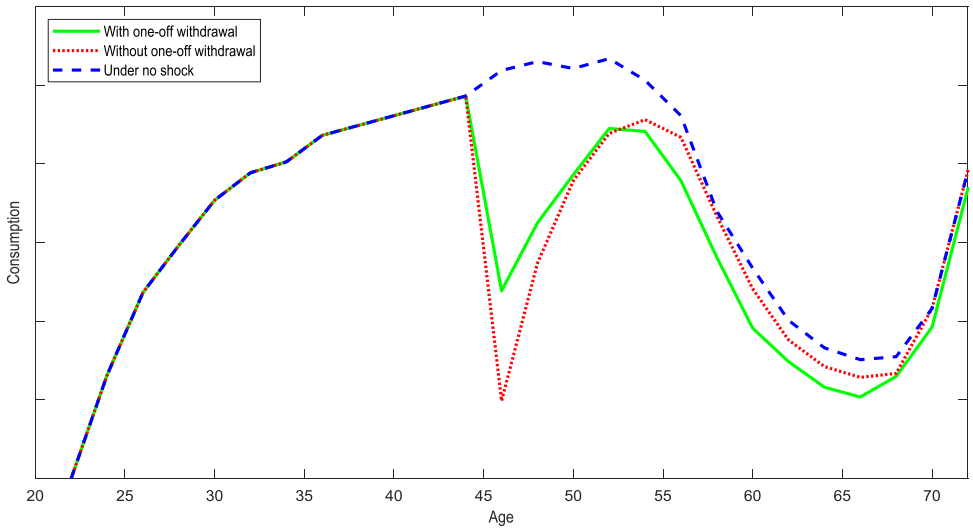

Figure 1: Household Consumption Path (30% withdrawal allowance)

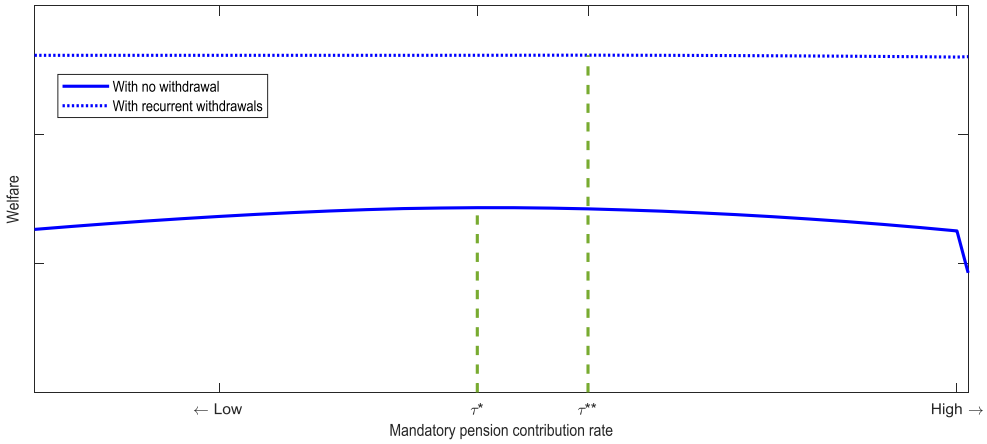

Figure 2: Optimal pension rates (30% withdrawal allowance)

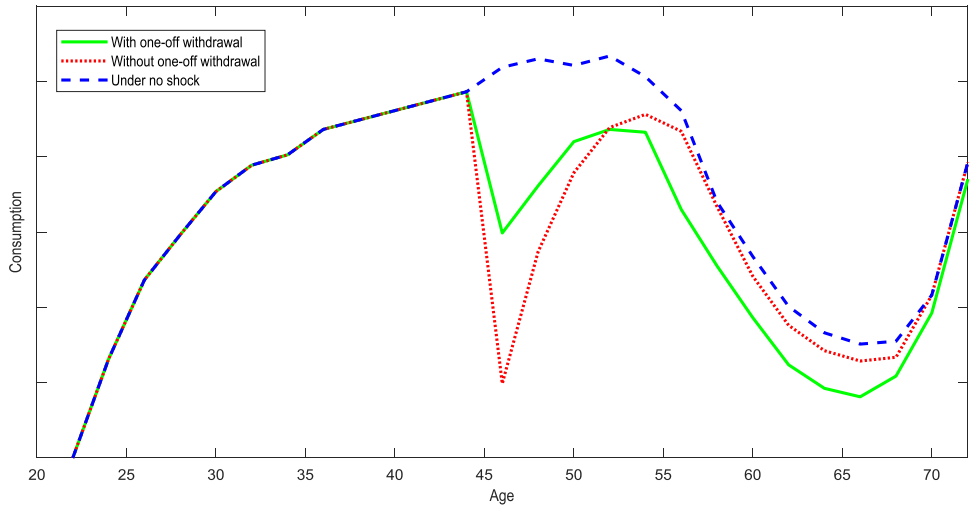

Figure 3: Household Consumption Path (50% withdrawal allowance)

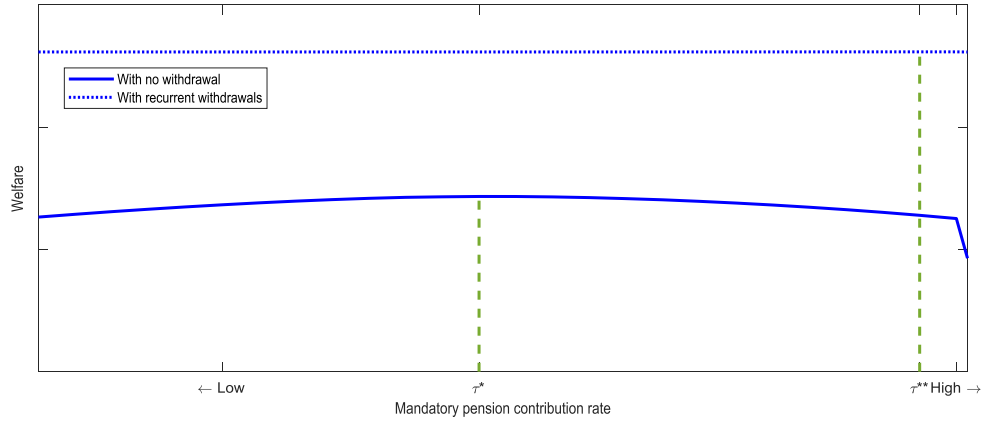

Figure 4: Optimal pension rates (50% withdrawal allowance)

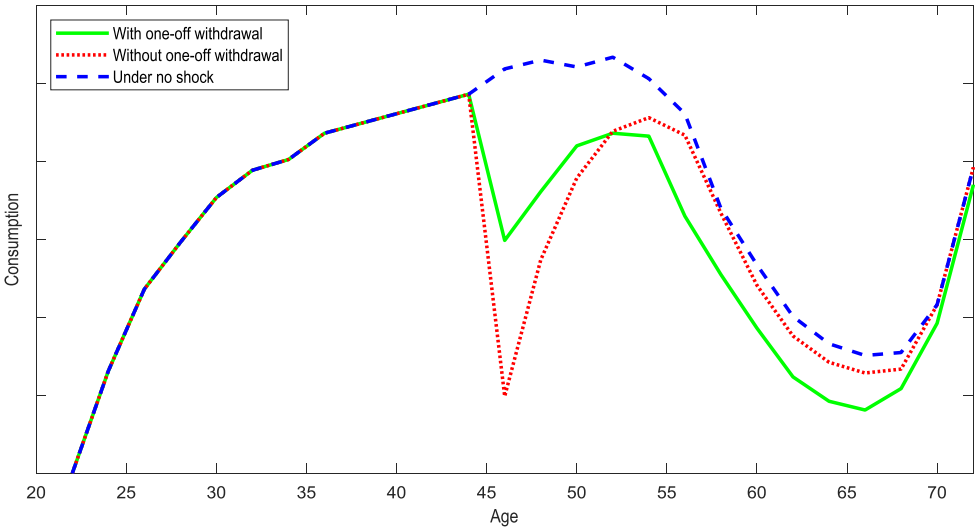

Figure 5: Household Consumption Path (60% withdrawal allowance)

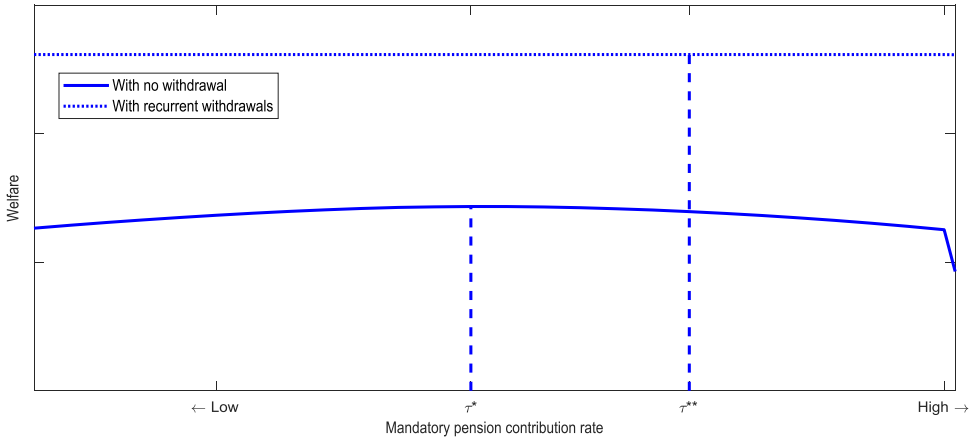

Figure 6: Optimal pension rates (60% withdrawal allowance)

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