

# A Methodology to Assess Indicative Costs of Risk Financing Strategies for Scaling Up Ethiopia's Productive Safety Net Programme

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## Abstract

This paper proposes and illustrates a methodology to assess the economic cost of the sovereign risk finance instruments available to the Government of Ethiopia and its development partners for financing the shock-responsive scalability component of the Productive Safety Net Programme. The methodology involves: (i) specifying rules for when additional

expenditures would be triggered in each woreda; (ii) specifying alternative risk finance strategies; and (iii) analyzing the costs of each risk financing strategy, including sensitivity and scenario testing of the results. The methodology is applied to a hypothetical set of rules for drought-responsive scalability, and a range of potential risk finance strategies.

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# A Methodology to Assess Indicative Costs of Risk Financing Strategies for Scaling Up Ethiopia's Productive Safety Net Programme\*

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## 1 Introduction

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Climate risk has significant implications for economic development and living standards in Ethiopia. One of the Government of Ethiopia's planned responses to this risk is the Productive Safety Net Programme (PSNP), a safety net program for chronically food insecure households in rural Ethiopia that has been designed to be able to be scaled in years of drought to provide supplementary support to households. However, the effectiveness of this scaling up of the PSNP depends on the effectiveness of the underlying financing – if additional financing in a drought year is insufficient and slow, response will be insufficient and slow.

Financial planning for the scalability mechanism of PSNP requires thinking through potential costs and benefits of a range of financial and budgetary instruments, including emergency budget reallocations, contingency funds, insurance, and emergency appeals from the international community. Comparative financial analysis of this full range of instruments in a single coherent framework is challenging, but without this informed decision making is particularly challenging. The objective of this paper is to present a methodology for quantitative assessment of the costs and benefits of risk financing strategies to support fast, drought-responsive scaling up of the PSNP. The paper also illustrates how the trade-offs and uncertainties associated with different financial instruments can be quantitatively evaluated when considering alternative risk financing strategies. The proposed methodology builds on that of Clarke et al. (2016), and the practical application to Ethiopia's PSNP may be informative both for the case of Ethiopia, as well as for other climate-responsive social protection systems.

The structure of this paper is as follows. First, this paper specifies in Section 2 a set of hypothetical rules for how and when the PSNP would scale up in response to shocks, and therefore we clearly define the contingent financial liability of PSNP. Second, in Section 3 we propose three hypothetical risk financing strategies and present assumptions about the economic and commercial environment. Finally, in Section 4 we analyze the cost of each risk financing strategy, both on an average basis and for different shock severities. Sensitivity and scenario testing of results is presented to illustrate how the costs might differ under different assumptions, or under different specifications for PSNP scalability. A glossary is included in Annex 1 outlining key terminology used in this paper.

### Approach and Limitations

The analysis presented in this paper makes assumptions about disaster risk, economic environment, and risk transfer instruments. The analysis considers hypothetical risk financing strategies for the PSNP costs, assuming perfect knowledge of the planned PSNP expenditures for different drought severities. This analysis is based on historic drought and population information. Information used in the analysis was both quantitative (e.g. additional drought-affected people based on historic rainfall) and qualitative (e.g. description of the PSNP) in nature. The information was of a high quality and broadly sufficient for the intended purpose. Where possible relevant sensitivity analyses were performed on the assumptions made.

For the avoidance of doubt, this paper does not present a World Bank or Government Actuary's Department view of actual poverty estimates or the actual contingent liability of the PSNP to drought in

Ethiopia. This paper does not propose a risk financing strategy for the PSNP, nor does it define or consider the source of any funding. It merely presents a framework within which such questions could be analyzed.

## 2 Defining an Illustrative Contingent Liability for the Shock-Responsive PSNP

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### Background on the PSNP

The Productive Safety Net Program was launched in 2005 as an alternative to the historic use of emergency food aid in Ethiopia to meet the basic needs of families in rural areas even during years when the rain, and production, was normal. International appeals for emergency assistance were launched each year, reaching, on average, just over five million people from 1994 to 2004. Against this backdrop, the PSNP aims to provide a predictable response to chronic food insecurity in drought-prone areas of rural Ethiopia. In 2005, the PSNP provided support to 5 million people, this has since increased to 8 million in 2015. The PSNP is managed by the Government of Ethiopia and implemented largely through government systems<sup>4</sup>. Transfers are made in cash or food each month to households for a six month period. Households with able-bodied adult members are asked to work in exchange for the transfers and these public works are designed to address the underlying causes of food insecurity in program areas<sup>5</sup>. Households without members who can work receive direct support<sup>6</sup>. A suite of independent evaluations show that the PSNP has significantly improved the food security status of beneficiaries and is an important driver of poverty reduction in Ethiopia.

Currently, the annual expenditures of the PSNP is approximately US\$750 million (including contingency budgets and administration expenses) and is the second largest safety net program in Sub-Saharan Africa.

Since 2005, the PSNP has been designed to be able to scale up in times of drought. The range of budgetary and financial instruments supporting this scaling-up for the program has evolved based on operational experience and lessons learned. Currently, the PSNP has contingency budgets managed by the (i) *woreda* administration; and (ii) federal government. The *woreda* contingency budget is an annual budget allocation that is used by *woreda* administrators to respond to local shocks, such as drought or floods<sup>7</sup>. The Federal Contingency Budget (FCB) is an annual budget allocation (currently US\$50 million) that is allocated by the federal government to (i) provide support to households negatively affected by a shock that are no in the PSNP core caseload; (ii) increase the duration of support (beyond six months) to PSNP clients; and, (iii) increase the value or frequency of the PSNP transfers to clients. The FCB is deployed base on the government's assessment of need, which is currently through the *seasonal assessment process*. The FCB is part of a continuum of response that sequences PSNP support to households with that of the humanitarian response system as transitory food insecurity evolves as a result of a shock. This coordinated response across the PSNP and humanitarian system rests on the fact that these instruments are deployed, by in large, through the same systems of government.

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<sup>4</sup> The exception is the support from USAID, which is delivered through NGOs.

<sup>5</sup> Since 2010, the PSNP safety net transfers have been complemented with investment in livelihood activities to support households move sustainably out of poverty.

<sup>6</sup> Otherwise known as unconditional transfers.

<sup>7</sup> The *woreda* contingency budget is also used to (i) address exclusion errors; (ii) appeals for inclusion in the program that are successfully raised; and (iii) idiosyncratic shocks.

The design of the FCB draws on the lessons learned from the Risk Financing component of the PSNP, which was triggered in 2009, 2011, 2014 and 2015 following periods of drought. The FCB for 2015/26 was approximately US\$50 million.

### **The Illustrative Contingent Liability**

The PSNP has been designed to be able to scale up in times of drought, providing benefits to additional households beyond the core caseload. This use of the contingency budgets of the PSNP has been carried-out in concert with the humanitarian appeal, which has continued to launch international appeals for food assistance. However, often the amount of additional benefits provided in times of drought through the PSNP and humanitarian system is driven by the availability of financial resources. This makes financial analysis of disaster risk finance strategies difficult as changes in the financial strategy can also impact the extent to which the PSNP will scale up and the humanitarian system will respond. Also, the availability of resources has little to do with the actual need on the ground, and so the scale up of the PSNP and humanitarian system should theoretically be based on need rather than resources.

To sidestep this challenge, the key assumption of all subsequent analysis in this paper is that pre-agreed rules are in place which fully define the supplementary funding provided to woredas in times of drought. These rules are assumed to be fixed, regardless of the financing strategy in place. With pre-agreed rules, the total financial expenditure of a scale-up under each scenario will remain constant. With expenditure fixed, it is possible to focus on the *financial* costs and benefits of alternative risk financing strategies, appraising the different risk financing strategies in their ability to cost-effectively finance the pre-specified contingent financial liability. For this analysis we make hypothetical assumptions about the rules for supplementary funding provided to woredas in times of drought, based on a crude microeconomic analysis of drought-induced transitory poverty. Other papers have proposed a range of benefits from implementing a rules-based approach for PSNP scale-up and humanitarian response, including speed, accuracy (Drechsler 2016) and provision of good incentives to woreda administrations and vulnerable populations (Clarke and Wren-Lewis 2016). This paper does not consider the costs or benefits of moving to a rules-based approach, but rather it focuses on potential financing strategies if the PSNP were to move to a rules-based approach.

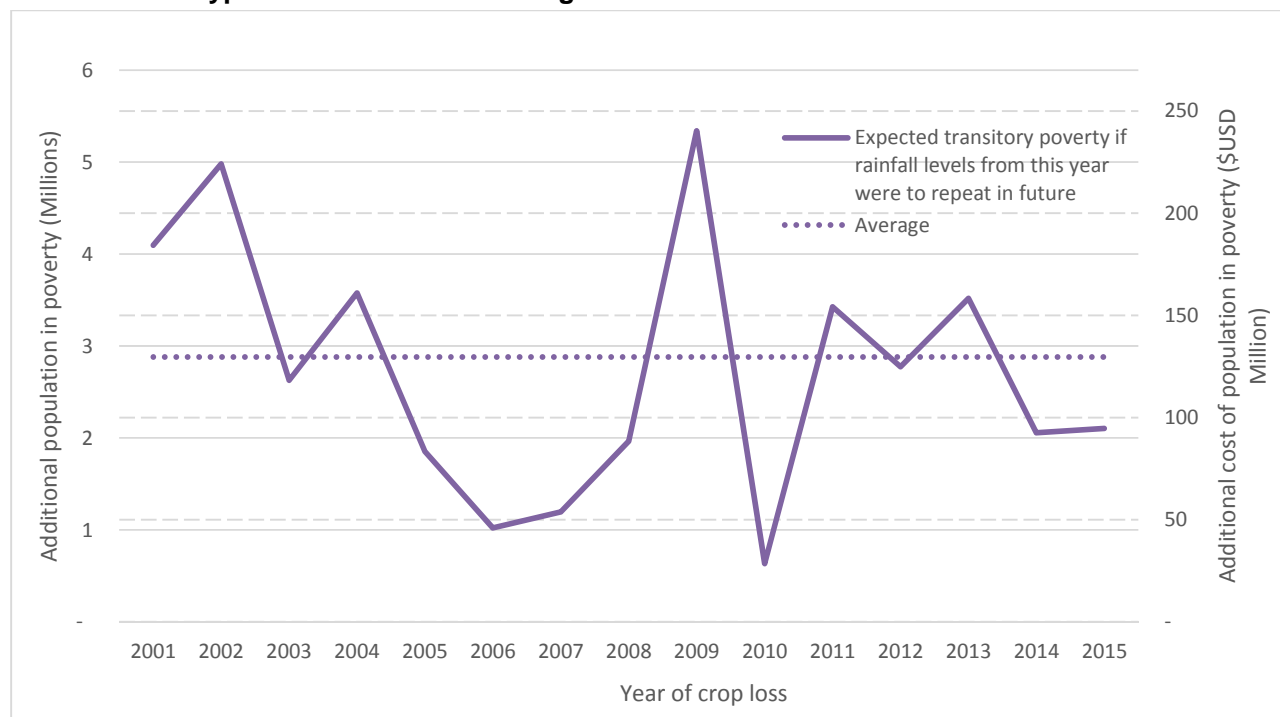
To further focus our analysis on the financial costs and benefits of alternative risk financing strategies, in the analysis that follows we assume that the cost of delivering the additional benefits is fixed, and does not depend on the financing strategy. To do this, we assume that the additional benefits to be financed through the risk financing strategies are delivered through the scaling-up of the PSNP. This allows us to use the existing unit cost of delivering the PSNP, as described below. In using this approach, the paper is not taking a view on whether one delivery mechanism is better than another or that the costs of delivery are higher or lower. Rather, the purpose is to allow us to focus the analysis squarely on the risk financing issues at hand. The methodology proposed in the following sections could equally be extended to allow for different delivery instruments, provided that the differential costs of delivery could be estimated.

In this paper the hypothetical PSNP scale-up rules and corresponding contingent liability were constructed using the crude econometric methodology detailed in Annex 2. First, historical household survey data and satellite data on drought intensity were combined to estimate how different rainfall patterns, as measured by a satellite-based index of rainfall deficit (the Water Requirements Satisfaction Index, WRSI), might be

expected to increase poverty in each woreda. The econometric methodology applied for this step does lead to unbiased estimates of poverty, but is likely to not be accurate enough to be implemented as actual scale-up rules for the PSNP. However, since the objective of this paper is not to propose a concrete set of rules, per se, but rather to illustrate how financial analysis could be conducted for rules-based approaches more generally, we proceed with these crude rules. (In Section 4 we do also conduct sensitivity analysis to illustrate how the cost of different risk financing strategies would change if different rules were chosen.)

These rules were then applied to historical WRSI data to calculate the number of PSNP beneficiaries there would be in each woreda under these rules if rainfall patterns in each of the years 2001-2015 were to repeat themselves in future. This 15-year data period was chosen due to the availability of consistent rainfall data which was applicable in estimating poverty in a baseline year. It is assumed that the PSNP core caseload is covered by the existing PSNP budget and therefore these numbers for total beneficiaries were then converted to numbers of beneficiaries from the scalability component of PSNP by subtracting the 8 million core caseload from the historic poverty estimates for each year in 2001 to 2015.<sup>8</sup> These figures for the number of beneficiaries were converted to expenditures using an assumed expenditure per beneficiary of \$US47.25 (US\$45 plus 5% to account for the cost of delivery), and US\$45 was chosen to represent an expenditure of US\$1.50 per additional beneficiary per day, for five days per month, six months per year. The results of this analysis are displayed in Figure 2.1.

**Figure 2.1: Number of additional beneficiaries and additional expenditure under assumed hypothetical rules for scaling of PSNP**



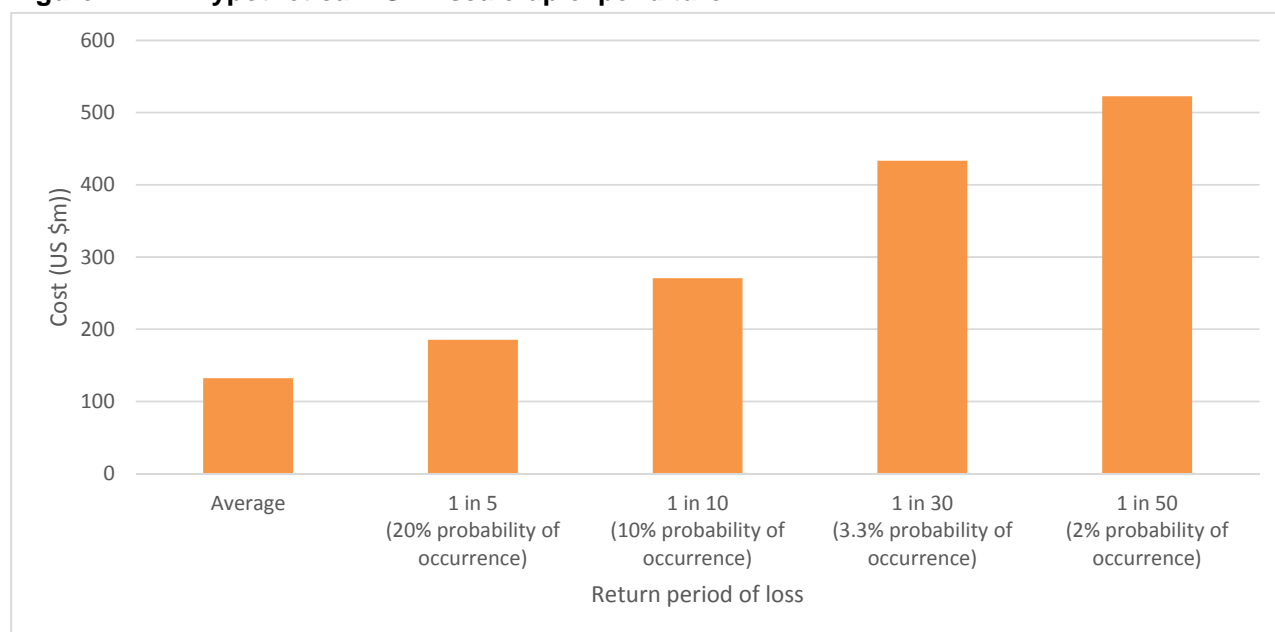
<sup>8</sup> The 2001 year refers to the 2001-2002 agricultural year that commences in 2001, with the same terminology applying to any other references to the years.

Finally, the annual data on the expenditures required for PSNP scale-up if the rainfall patterns in previous years were to repeat was extrapolated to give 5,000 years of simulated expenditures by fitting a Pareto distribution.

Under these hypothetical rules, on average 2.9 million people would be supported under the scalability component of PSNP and the average required expenditure under the scalability component is approximately US\$139 million. Based on the historical data and hypothetical PSNP scale-up, expenditures would be highest if the 2009 drought was to repeat (5.3 million additional beneficiaries with expenditures of US\$252 million) and lowest if weather in 2010 was to repeat (0.6 million additional beneficiaries with expenditures of US\$30 million).

The average contingent liability as well as the contingent liability at different return periods (i.e. events with different probabilities of occurrence based on the 5,000 simulated years) are presented in Figure 2.2 below. Variations in the contingent liability were also considered, details of which can be found in Annex 6.

**Figure 2.2: Hypothetical PSNP scale-up expenditure**



### 3 Characterizing Risk Financing Strategies

Having specified the illustrative contingent liability for the PSNP we now present three potential strategies for financing this contingent liability, along with a set of financial and economic assumptions.

The range of potential financial instruments<sup>9</sup> considered in this analysis include:

<sup>9</sup> Further detail on the types of financing instruments is provided in the glossary in Annex 1.

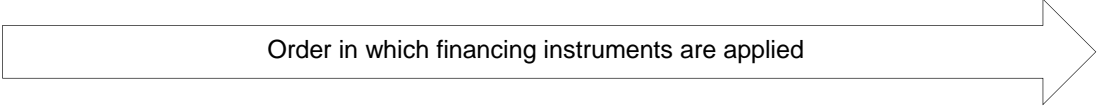


- > **Federal Contingency Budget:** the PSNP Federal Contingency Budget (FCB) is an annual budget allocation available to cover a range of potential expenditures. We consider the part of this budget that is ringfenced to address transitory food insecurity associated with drought.
- > **Insurance (Risk transfer):** insurance, reinsurance or capital market instrument such as catastrophe bond or catastrophe swap. With such an instrument government and/or development partners would pay an annual fee, and would receive claim payments according to pre-agreed rules. We assume that the rules which determine whether there is a claim payment precisely match the rules for scaling of the PSNP.
- > **Budget Reallocation:** government or donor emergency budget reallocation from other projects.
- > **Humanitarian Response:** donations through the Humanitarian Requirements Document (HRD) appeals process (for example, see Government of Ethiopia, 2016).

The source of funding is ignored in this analysis with the study focused only on the cost-effectiveness of each financial instrument. For example, budget reallocations could be financed by either the Government of Ethiopia or development partners. The paper presents budget reallocations as a single instrument and the reader is free to interpret the cost of budget reallocations as arising from the cost of the Ethiopia government reallocating funding from planned expenditures or from development partners reallocating funding away from planned expenditures.

Three primary hypothetical risk financing strategies were considered in the analysis as set out in Table 3.1 below, and variations of these strategies are also considered in Section 4.

**Table 3.1 – Risk Financing Strategies**

Strategy	Federal Contingency Budget (FCB)	Insurance	Budget reallocation	Humanitarian Response (HRD)
				
<b>A</b>	US\$50 million available	Not available	Not available	Unlimited
<b>B</b>	US\$50 million available	Covers 100% of expenditure between US\$50 million and US\$455 million. Maximum payout of US\$405 million available.	Not available	Unlimited
<b>C</b>	US\$50 million available	Not available	US\$100 million available	Unlimited

Key assumptions were made in determining the amount of each financial instrument available and the order in which each instrument would be used upon PSNP scale-up. Key assumptions were as follows:

- > In all strategies, the FCB funds initial scale-up payments and other financial instruments do not become available or used until the total amount of available FCB has been exhausted. The available FCB was set equal to the 2015 FCB of US\$50 million. Variations in the amount of funds available through the FCB were also considered, details of which can be found in Annex 6.
- > Under Strategy B, insurance starts to pay out once the FCB of US\$50 million has been exhausted, and stops paying out once scale-up payments reach US\$455 million (the 1 in 30 year PSNP scale-up contingent liability). All expenditure between these two points is fully insured, therefore the maximum insurance payout is US\$405 million (US\$455 million less US\$50 million). The insurance premium for this defined coverage was determined based on an assumed market-based insurance pricing multiple.
- > Under Strategy C, the amount of available budget reallocation was assumed to be US\$100 million. This assumption has been made with reference to the recent budget reallocation by the government of Ethiopia of approximately US\$70 million for drought response. Budget reallocations of larger amounts are likely to be more costly and to incur greater hurdle rates<sup>10</sup>.
- > In all strategies it is assumed that the HRD (humanitarian response) acts as financier of last resort, only used after all other financial instruments have been exhausted. In practice HRD allocations are uncertain but for this analysis we assume that they can be relied on.

Economic and other financial assumptions in respect of the financial instruments are required for the analysis, details of which are included in Annex 3.

## 4 Main Findings

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### Base Case Scenario

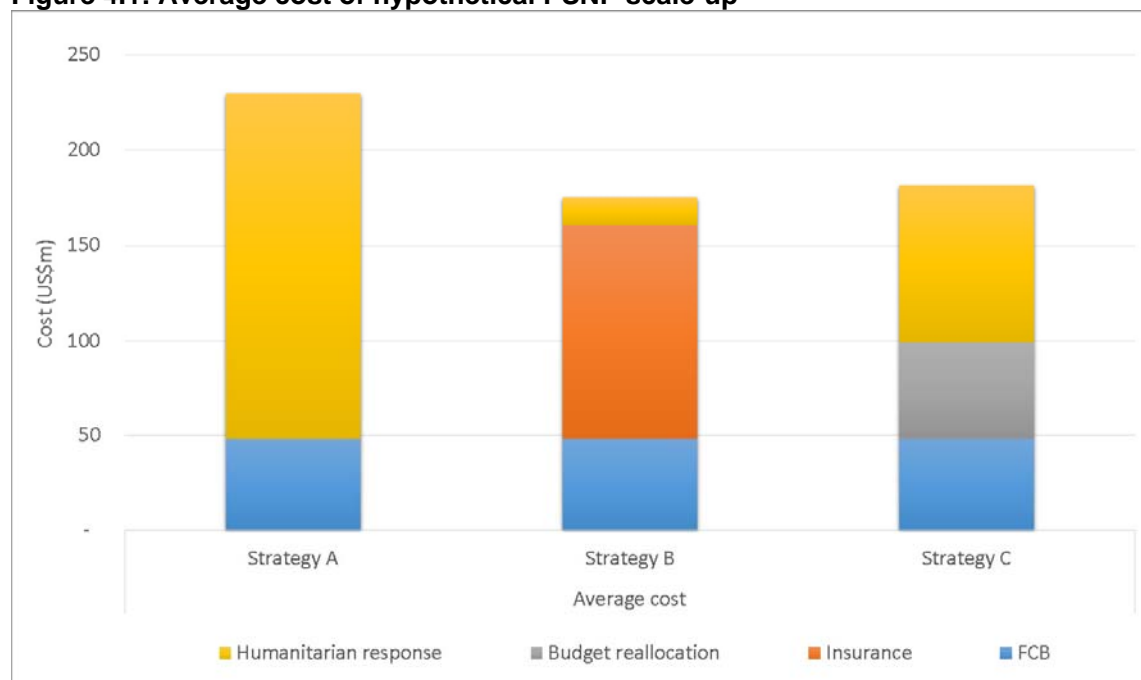
The cost of each risk financing strategy in each of the 5,000 simulated scenarios was determined using the formulae for opportunity cost derived in Clarke et al. (2016). In each of the 5,000 years the average cost is calculated as well as the cost at different return periods (events with different probabilities of occurrence). For the purpose of this paper we report the average, 1 in 5 year and 1 in 30 year cost of each strategy.

The average expenditure to be financed is US\$139 million, covering an average of 2.9 million additional beneficiaries per year, and the average cost of financing this liability ranges from US\$175 million to US\$ 230 million (Figure 4.1 and Table 4.2).

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<sup>10</sup> US\$70 million was the highest reallocation known at the time of this paper being written. Recent data in March-April 2016 suggest that the Government of Ethiopia may be committing to reallocate as much as US\$700 million from the oil reserve for future drought response, though the hurdle rate of this reallocation is unknown.

**Figure 4.1: Average cost of hypothetical PSNP scale-up**



**Table 4.2: Summary of average PSNP scale-up expenditure and average cost by strategy**

	Strategy A		Strategy B		Strategy C	
US\$ millions <sup>11</sup>	Average expenditure	Average Cost	Average expenditure	Average Cost	Average expenditure	Average Cost
<b>FCB</b>	47.9	47.9	47.9	47.9	47.9	47.9
<b>Insurance</b>	-	-	83.5	112.7	-	0
<b>Budget reallocation</b>	-	-	-	-	49.6	51.2
<b>HRD</b>	90.8	181.6	7.3	14.6	41.2	82.4
<b>Total</b>	<b>138.7</b>	<b>229.5</b>	<b>138.7</b>	<b>175.3</b>	<b>138.7</b>	<b>181.5</b>

In all scenarios the rules we assume lead to scaling up of PSNP somewhere in Ethiopia, in at least one woreda. In 22% of the 5,000 scenarios, approximately one year out of every five, the scale-up expenditure is less than US\$50 million and so can be fully financed through the FCB. However, in 78% of the 5,000 scenarios, approximately four years out of every five, the FCB is fully depleted.

For Strategy B, for losses above the FCB, the insurance layer gets fully depleted in only 3% of the 5,000 scenarios considered. That is, the total scale-up expenditure is greater than US\$455m (the maximum insurance payout point) only 3% of the time.

<sup>11</sup> Figures may not add due to rounding

In Strategy C, for losses above the FCB, budget reallocation gets fully depleted in 28% of the 5,000 scenarios considered. That is, the total scale-up expenditure is greater than US\$150 million (US\$50 million from FCB and US\$100 million from budget reallocation combined) 28% of the time.

The differences between scale-up payments and the related cost vary depending on each financial instrument. These differences are due to the economic and financial assumptions made (as outlined in Annex 3), namely:

- > The average cost of financing payments through the FCB is very marginally greater than the average expenditures. This is due to the interest rate incurred being higher than the investment return available, and a related cost on the unused portion of FCB when it is not fully utilised in covering the scale-up payments.
- > The average cost of financing PSNP scale-up through budget reallocation is marginally greater than the scale-up payments. This is due to the spread caused by budget reallocation hurdle rate (rate of return on foregone investments) being higher than the discount rate.
- > The average cost of financing PSNP scale-up through insurance is greater than the scale-up payments. This is due to the price paid for insurance (pricing multiple of 1.35<sup>12</sup> applied to the average scale-up cost covered by insurance).
- > The average cost of financing PSNP scale-up through humanitarian response is significantly higher than the scale-up payments. This is due to the assumption that US\$1 of payments will cost US\$2 given the assumption of a delay between the event occurring and the benefit being paid.

On average, Strategy B is the most cost-effective risk financing strategy. This is mainly due to the large amount of insurance assumed to be available compared to the limited amounts of FCB and budget reallocation available, and the cost effective nature of the insurance given the assumption of the relatively low pricing multiple.

- > On average, insurance is relatively cost effective compared to humanitarian response due to the insurance pricing multiple (1.35) being relatively lower than the humanitarian response delay factor (2.0).
- > Much larger amounts of funds are assumed to be available through insurance (up to US\$405 million) compared to FCB (US\$50 million) or budget reallocation (up to US\$100 million). Under Strategy B, humanitarian response was only required in 3% of the 5,000 scenarios i.e. only once in approximately every 30 years humanitarian response would be required under Strategy B.
- > The limited availability of FCB and budget reallocation, together with the lack of insurance, mean that Strategy A and C demand greater use of humanitarian response to finance PSNP scale-up payments compared to Strategy B.
- > As Strategy B relies on insurance for payouts, and insurance is cheaper than HRD, Strategy B is significantly less expensive than Strategy A or Strategy C.

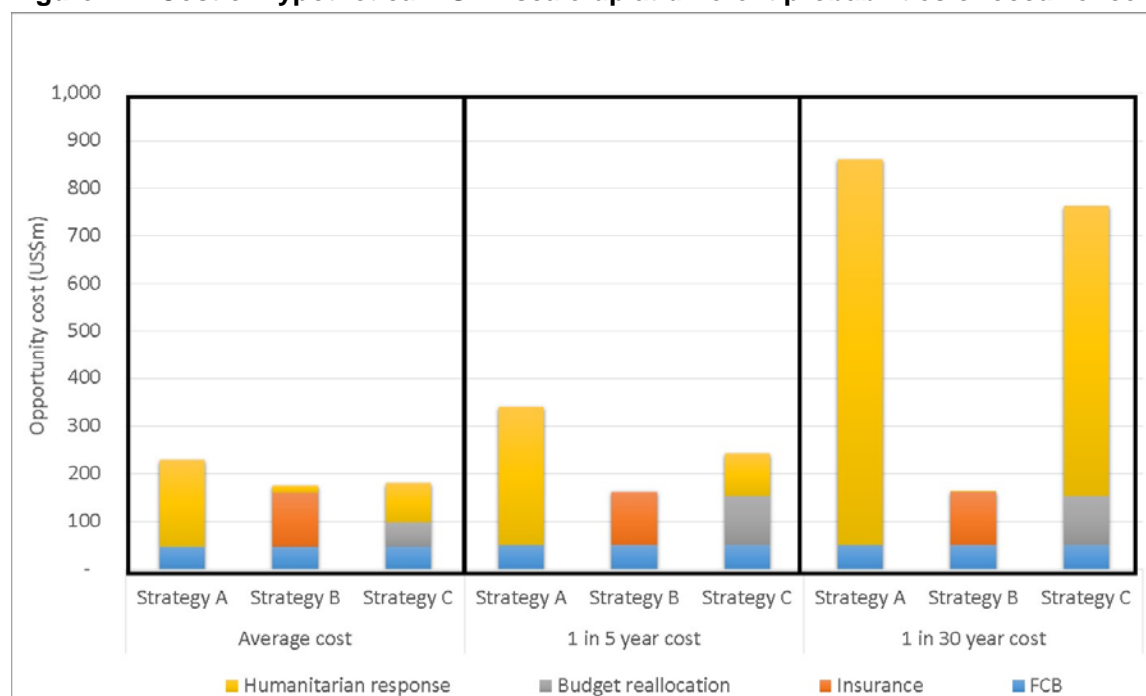
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<sup>12</sup> Multiple used is an estimate for the purposes of this analysis and the actual multiple would be dependent on prevailing insurance market conditions at the time.

As the contingent liability increases, the value of insurance becomes even more pronounced and Strategy B remains the lowest cost Strategy as demonstrated in Figure 4.2. Based on the hypothetical PSNP scale-up mechanism the contingent liability for certain events is outlined below:

- > For a 1 in 5 year drought (which has a 20% probability of occurrence), an additional 4.1 million people will be in transitory poverty. The corresponding additional PSNP scale-up payments (1 in 5 year contingent liability) is approximately US\$195 million.
- > For a 1 in 30 year drought (which has a 3.3% probability of occurrence), an additional 9.6 million people will be in transitory poverty. The corresponding additional PSNP scale-up payments (the 1 in 30 year contingent liability) is approximately US\$455 million.

**Figure 4.2: Cost of hypothetical PSNP scale-up at different probabilities of occurrence**



The value of insurance is pronounced when looking at drought events of high severity (i.e. higher than average scale-up payments) but which have a low probability (chance) of occurrence. 1 in 5 year and 1 in 30 year events have a 20% and 3.3% chance of occurrence respectively. If these events occur the cost of Strategy B is significantly less than the cost of Strategy A or C, due to the large amount of insurance available, as demonstrated in Figure 4.2.

Strategy B is more cost-effective than Strategy A about half of the time, but when it is more cost-effective, it tends to be significantly more cost-effective. As the amount of PSNP scale-up payments increases, the savings from having risk financing Strategy B in place compared to Strategy A continually increase. This is demonstrated in the variability analysis in Annex 4.

Strategy C, with limited available budget reallocation, is consistently more cost-effective than Strategy A. The cost savings of Strategy C compared to Strategy A peak when PSNP scale-up payments equal

US\$150 million (the total amount of available FCB plus budget reallocation) i.e. before humanitarian response is required under Strategy C. This is demonstrated in Annex 4.

### Sensitivity Results: Varying the Economic and Financial Assumptions

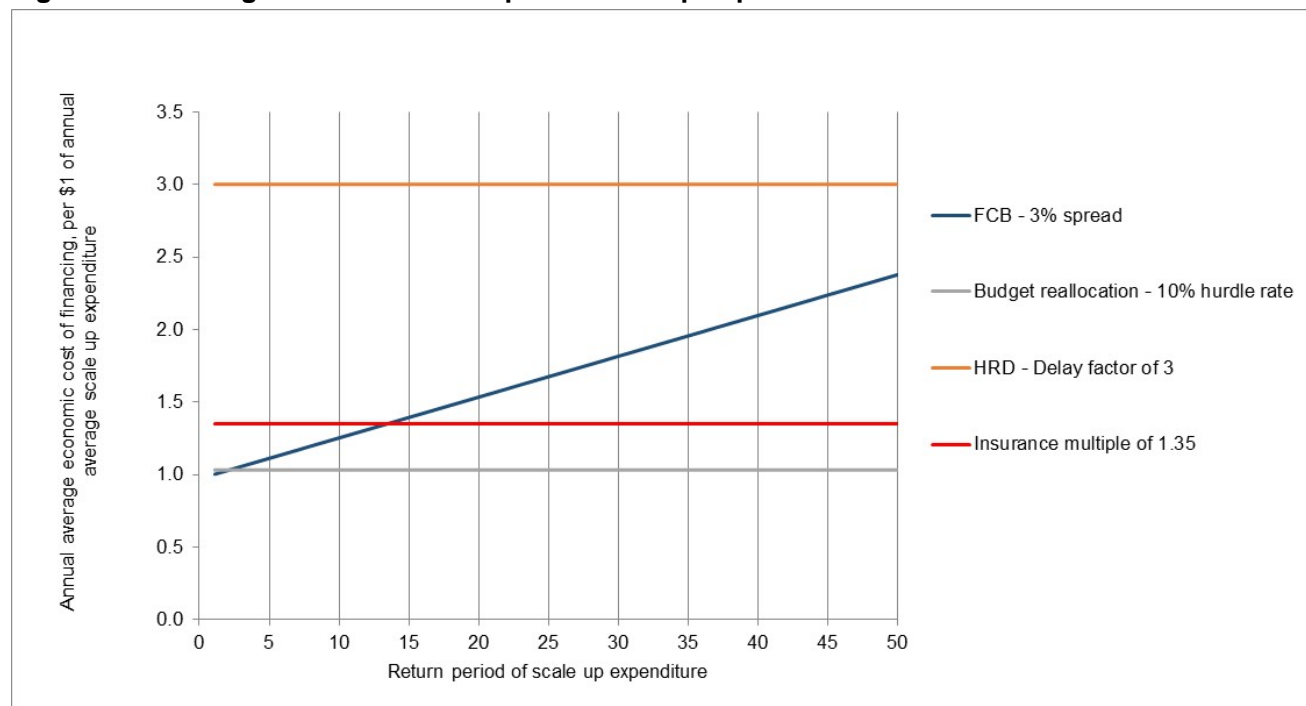
Variations in the economic and financial assumptions were tested and the corresponding impacts on the costs of funding PSNP scale-up payments through each of the financial instruments was analyzed. A marginal cost methodology as set out in Clarke et al. (2016) has been used to compare the marginal cost of each financial instrument. The marginal cost represents the additional (opportunity) cost of each financial instrument as the return period of the contingent liability increases. An increasing return period corresponds to a decreasing event frequency or an increasing magnitude of expenditure.

The marginal cost does not reflect the limitations and budgetary constraints of various financing sources – most notably funds available through budget reallocation are cost effective but very limited.

The following graph (Figure 4.3) compares the marginal cost (as a multiple of the scale-up expenditure) for the various financing sources under the base case assumptions and aims to demonstrate the optimal risk financing strategy given the cost assumptions.

The lower the line in the graph below, the lower the cost of the financing instrument demonstrates as a multiple of the expenditure that’s funded. Therefore, for any magnitude of loss (which increases along the x-axis as the return period increases), the cheapest marginal financing instrument will be whichever has the lowest cost value at the corresponding return period.

**Figure 4.3: Marginal cost as a multiple of scale-up expenditure - base case scenario**



- > The FCB has an increasing marginal cost due to the higher cost of borrowing funds (the interest rate) than the investment return earned on funds held in reserves. If the FCB was held at a level covering greater losses (at higher return periods), the FCB would be less likely to be called on and thus more likely to incur a cost.
- > The HRD has a cost of exactly 2 times the expenditure at all return periods by definition of the delay factor of 2. It is assumed that US\$1 of aid provided early costs US\$2 when the response is provided late.
- > Budget reallocation has a constant marginal cost of approximately 1.03 times the expenditure under the base case assumptions, with 3% being approximately the spread between the hurdle rate (10%) and the discount rate (6.625%).
- > Insurance has a cost of 1.35 times the scale-up expenditure, reflecting the 1.35 insurance pricing multiple. The multiple is based on the average claim payment, and is here considered that attaching insurance at a marginal. In practice, the cost as a multiple of expenditure may be lower for higher expenditures since the premiums are paid upfront, and for higher losses it is the insurer that's out of pocket.

Based on the base case assumptions made, Figure 4.3 demonstrates the following intuition:

- > Budget reallocation is always the cheapest source of financing due to the low and constant spread between the hurdle rate assumption (10%) and the discount rate (6.5%).
- > For total payments with greater than an 8% chance of occurrence (i.e. total payments below a 1 in 13 year return period) FCB is the second cheapest source of financing (due to the spread between the interest rate and the investment return earned on funds).
- > For total payments with less than an 8% chance of occurrence it is cheaper to finance these costs using insurance than the FCB.
- > Humanitarian response is always the most expensive way of financing payments due to the delay between the payments being required and the response being received.

The following observations are noted based on the sensitivity tests completed on the economic and financial assumptions and are in line with intuition, with further detail in Annex 5:

- > Increasing the insurance pricing multiple increases the cost of insurance and therefore decreases the cost benefit gained from insurance.
- > Increasing the humanitarian response delay factor from 2.0 results in humanitarian response being an even less attractive financing source. However, decreasing the delay factor to 1.5 results in humanitarian response being a more attractive financing source than insurance for drought events/payments with a high probability of occurrence (low total payments).
- > Increasing the spread between the investment return and interest rate increases the cost of financing through the FCB.
- > Increasing the budget reallocation hurdle rate increases the cost of financing through budget reallocation.

## Sensitivity Results: Varying the Contingent Liability and the Amount of Available Funds

Varying the contingent liability has a significant impact on the results, particularly the cost effectiveness of insurance in Strategy B.

- > Decreasing the contingent liability by 25% reduces the savings of Strategy B and in fact makes Strategy B more expensive than Strategy C at lower return periods. This is because for a significantly lower contingent liability, the FCB is more likely to be able to fund the entire contingent liability. The FCB is available to cover on average a greater proportion of the payments than when the contingent liability was higher.
- > Increasing the contingent liability has the opposite effect – FCB is even more likely to be exhausted and insurance remains a more cost effective financing instrument than HRD.

Another sensitivity analysis outlined in Annex 6 considers the effect of increasing the amount of available FCB and thereby increasing the insurance attachment point accordingly. Results support the conclusions already demonstrated in the base case marginal cost analysis, that increasing the amount of the FCB is a cost effective financing method when considering financing the average contingent liability (and contingent liabilities with high probabilities of occurrence i.e. low total payments). However if considering contingent liabilities with low probabilities of occurrence (e.g. 3.3% or 1 in 30 year payments) then increasing the FCB is not cost effective.

## 5 Concluding Remarks

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This paper set out a methodology to answer the questions:

- > How can the costs of risk financing strategies for PSNP scale-up be quantitatively assessed and compared?
- > What are the trade-offs and uncertainties associated with different financial instruments which should be evaluated when considering alternative risk financing strategies?

Our analysis is for a specific hypothetical version of PSNP scalability where woredas receive fast, automatic budget reallocations based on an objective WRSI-based early warning system. However, we believe that the methodology used to assess and compare risk financing strategies set out in this paper would carry over to other rules-based approaches for woreda-level scaling of PSNP.

The financial cost is only one component of the decision:

- a. *Budget reallocations are constrained and higher amounts of budget reallocations may incur higher costs.* In this paper a limit of US\$100 million of developmentally ‘cheap’ budget reallocations was assumed. The cost of budget reallocations could be much higher for larger reallocations, when budgeted development projects may be disrupted by budget reallocations.
- b. *The availability and size of the FCB could be constrained by political economy or public financial management considerations.* If too large an FCB is put in place, there is a risk the funds might be used for purposes other than those originally intended.



- c. *Insurance suffers from 'regret' – there is a chance of premium payment with no payout received from the insurance coverage.* If insurance is purchased and there is a good year with no drought (so no insurance payout is received) then it might be viewed that the insurance was a bad investment. Integrating insurance-type financing into PSNP would require a good level of understanding across government and donors of both the benefits and limitations of insurance.
- d. *Humanitarian response may not be available to finance the costs of large shocks.* In this paper we assume that humanitarian response can be relied on for financing specific expenditures, although in practice the amount of financing available through the HRD process is uncertain.

For illustrative purposes, a hypothetical specification of the PSNP, with scaling up in excess of the core caseload based on pre-agreed rules was defined. This allowed the paper to present a methodology for quantitative assessment of the risk financing strategies to support this scale-up, and illustrate the trade-offs and uncertainties with different financial instruments.

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## Annex 1 - Glossary

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Contingent liability	<p>A potential payment obligation that may be incurred depending on the outcome of a future event.</p> <p>In this analysis, the contingent liability is the potential costs of providing assistance to additional food insecure households due to drought through the PSNP.</p> <p>The contingent liability is the cost of benefits to additional PSNP beneficiaries (the transitory poverty) above the PSNP core caseload.</p>
Cost / Opportunity cost	<p>The cost of an alternative use of the finance that must be forgone in order to pursue a certain strategy. Throughout this paper, references to cost imply opportunity cost.</p>
Delay factor	<p>The multiple applied to delayed debt financing of costs – a delay factor of 2 implies that providing delayed funding has an opportunity cost of US\$2 for every US\$1 of scale-up costs financed.</p>
Discount rate	<p>A rate used to calculate present values of future cash flows. For example, with a discount rate of 5%, \$1.05 in 1 year is equivalent to \$1 at present.</p>
FCB	<p>Federal Contingency Budget. The Federal Contingency Budget (FCB) is a pre-funded budget line available to finance PSNP expenditures in excess of the core caseload expenditures, triggered in periods of increased drought.</p>
HRD	<p>Humanitarian Requirements Documents issued by the Government of Ethiopia and its humanitarian partners. The HRD is published annually or following a sudden-onset disaster and often includes relevant information on response expenditures detailed by sector, activity, and region (sometimes district).</p> <p>HRD within this paper refers to funding provided by the international humanitarian community following a disaster event.</p>
Hurdle rate	<p>Rate of return on foregone investments when budget reallocation is used to finance the contingent liability.</p>
Insurance	<p>A risk transfer arrangement by which an insurance company undertakes to provide a guarantee of compensation (claim payment) for a loss under specified conditions in return for payment of a specified premium by the insured.</p>
Insurance limit	<p>The maximum amount an insurance policy will pay out.</p>

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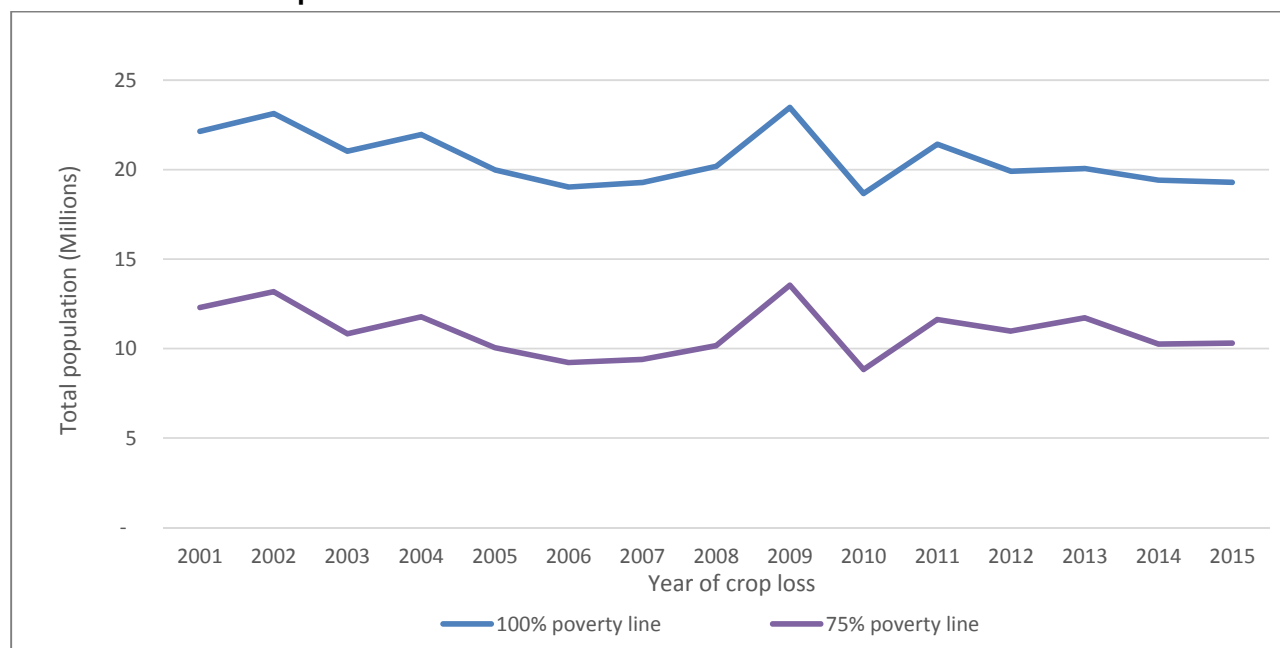
Marginal cost	The additional opportunity cost of each risk financing instrument (such as insurance) as the return period of the response increases.
PSNP	Productive Safety Net Programme, which is a social protection program for food insecure households in rural Ethiopia.
Return period (of loss)	<p>An indication of the likelihood of an event occurring; a recurrence interval demonstrating how frequently an event is expected to occur.</p> <p>For example, an event or a loss with a return period of 5 is statistically expected to recur every 5 years over an extended period of time (or has a 20% probability of occurrence).</p>
Risk financing strategy	A set of financing instruments combined to provide funds to cover the financial effect of unexpected losses.
Transitory poverty	Population in poverty in a year due to crop loss resulting from drought (WRSI < 100%).
Woreda	Woredas (or districts) are the third-level administrative divisions of Ethiopia. There are about 670 rural woredas and about 100 urban woredas in Ethiopia.
WRSI	The Water Requirement Satisfaction Index is an indicator of crop performance based on the availability of water to the crop during a growing season.

## Annex 2 – Methodology to Select Illustrative Rules for PSNP Scalability

### Selecting Historic Poverty Data

Underlying poverty data (poverty numbers by zone, 2001-2015, rural Ethiopia) was provided by Hill/Porter and is shown in Figure A2.1 below.

**Figure A2.1: Hill/Porter data showing the population in poverty based on in year WRSI and 2010/11 consumption data.**



The underlying poverty estimates were based on the following methodology:

- > Regress 2010/11 household survey consumption data on household data and 2010/11 Water Requirement Satisfaction Index ('WRSI') data to estimate a predictive formula for poverty, as a function of household data and WRSI.
- > Use this predictive formula to generate estimates of the number of people in poverty in each zone (each zone consisting of multiple woreda) for 2001-2015.

The following assumptions were made:

- > The poverty line was defined as the cost of 2,200 calories per adult equivalent per day, plus very basic non-food items (e.g. cooking fuel).
- > The data is based on modelling historical rainfall/crop loss data over the past 15 years with a baseline assumption for consumption, to estimate the population falling below the poverty line in each historic year.
- > There are a number of caveats related to the simulation of these population estimates. For example, there is no adjustment for consumption growth, and the model has not been adapted to account for any factors other than the difference in rainfall from one year to the next.

Two definitions of the poverty line were considered - total poverty and 75% of this line:

- > For each year, the number of people whose consumption falls below the consumption poverty line is plotted in figure A2.1. As the definition of poverty is reduced (for example from 100% to 90%) fewer people will fall below the poverty line.
- > The historical data suggests an average chronic poverty level of 8 million if there is no crop failure in a given year, when the poverty line is defined as 75% of its full value. This estimate of chronic poverty approximately aligns with the core caseload of the PSNP. To focus on transitory poverty, which is defined as poverty related to insufficient rainfall, a threshold of 75% of the total poverty line was assumed in this analysis.

### **Isolating Transitory Poverty**

In order to define the hypothetical contingent liability a simplifying assumption was made that the population in chronic poverty is covered by the core PSNP caseload. The excess population not covered by the core PSNP caseload must be covered by the scalability mechanism, and the mechanism:

- > Defines someone as chronically poor if they would be in poverty in a year with sufficient rainfall (WRSI=100%). Chronically poor are assumed to be protected by the regular caseload of PSNP.
- > Defines someone as transitorily poor if they would be in poverty in a year because WRSI<100%. Transitorily poor are assumed protected by the temporary in-season scaling of PSNP.

The base case results use the 75% poverty line, as the resulting estimate of the number of chronically poor is similar to the core caseload of the PSNP. Subtracting the chronic poverty estimate of 8 million from the total poverty estimates (both based on a poverty line of 75%) gives a per year estimate for those in transitory poverty for each of the 15 data points (2001 to 2015).

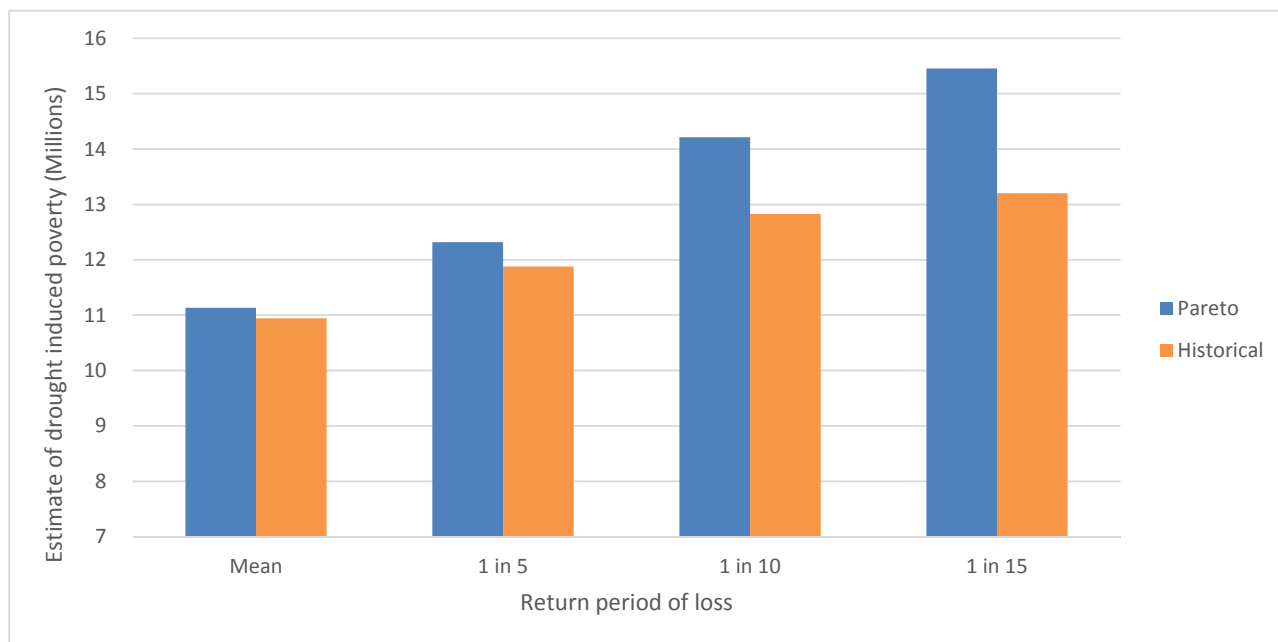
### **Defining a Contingent Liability Distribution**

A range of transitory poverty estimates is required for the analysis, so that the impact of risk financing strategies in both the average scenario and more extreme scenarios can be determined. A distribution assumption is required in order to consider return periods and likelihoods of occurrence, as well as to consider potential scale-up costs more extreme than those observed in recent history.

A Pareto distribution was fitted to the historic data for total population in poverty to extrapolate a set of scale-up payments for the hypothetical contingent liability. There were many options for a suitable distribution function and the Pareto was selected as a pragmatic choice, because it is a heavily skewed distribution. The historical data is plotted against the extrapolated data in the figure below.

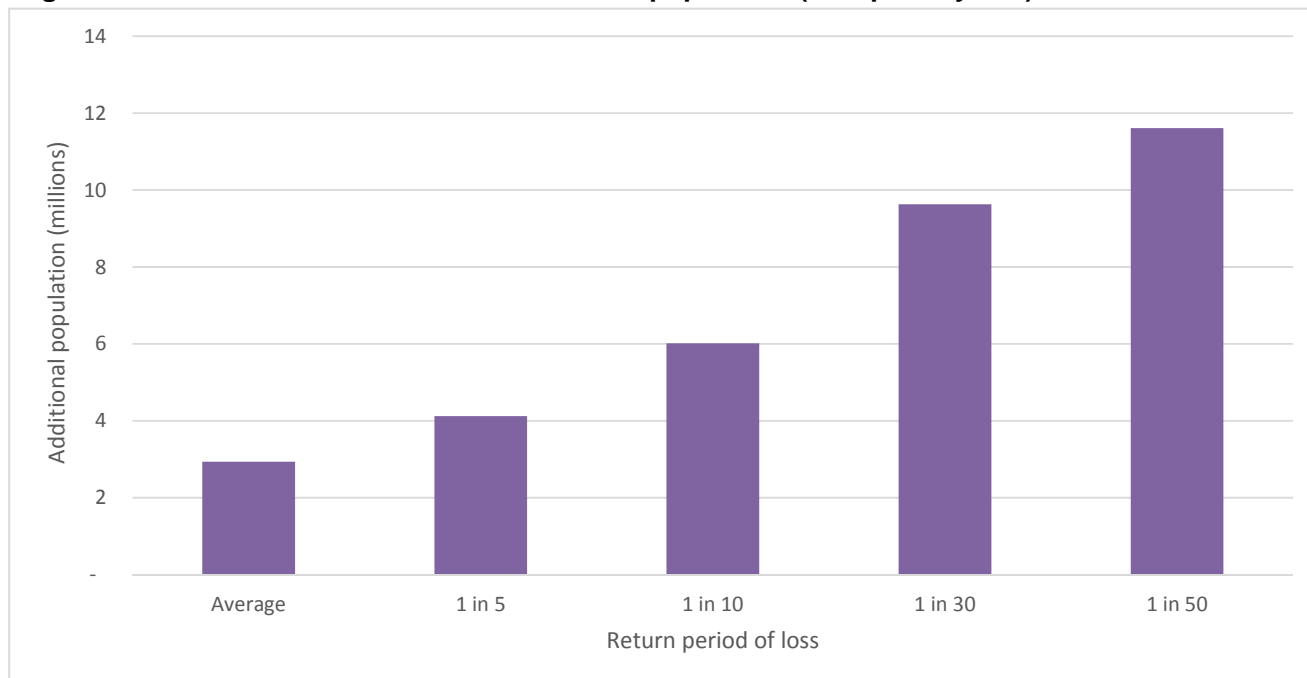
The extrapolated data was based on 5,000 random samples (simulations) taken from the fitted Pareto distribution. A larger sample did not produce a fit that was any closer to the historical data. The greater drought induced poverty estimates sampled from the Pareto distribution (compared to historical data) are a result of the skewness of the Pareto distribution.

**Figure A2.2: Extrapolation of historical estimates of drought-induced poverty (75% poverty line)**



Fitting a distribution to the 15 data points of total poverty allows the hypothetical number of recipients of PSNP scale-up to be calculated. This is simply calculated by subtracting the chronic poverty estimates from the extrapolated total poverty estimates. The analysis shows modelled annual data for the number of PSNP beneficiaries in excess of the core caseload. Figure A2.3 below shows the number of people in transitory poverty on average and at different return periods (event frequencies) based on the fitted distribution.

**Figure A2.3: Additional modelled food insecure population (75% poverty line)**



The per-person payment for additional beneficiaries is assumed to be US\$47.25 (US\$45 plus 5% for the cost of delivery), as advised by Ethiopia PSNP experts. US\$45 represents a benefit of US\$1.50 per person per day, for five days per month, six months per year. This assumption is based on the value of transfers made to beneficiaries under the PSNP (approximately US\$1.5 per day), the maximum number of days beneficiaries are entitled to work each month (5 days per month) and the number of months per calendar year during which assistance is provided to PSNP beneficiaries (6 months). This calculation assumes that scale-up benefits are only provided to new recipients and ignores any additional benefits provided to the existing core caseload.

#### **Comments on approach taken**

While the approach makes a range of simplifying assumptions, key advantages include that the approach is simple, unbiased, and transparent. The analysis was poverty-focused, in the sense that the scaling up rules have been generated to approximate zonal-level drought-induced transitory consumption poverty. The data is based on stationary exposure, because if historical poverty estimates or historical PSNP beneficiary numbers were used, the progression would be conflated with economic, social, or program changes over time. This approach isolates the impact of drought on poverty numbers, and asks what would have happened to poverty figures in 2010 if rainfall/WRSI in 2010 had been different (assuming the commercial, economic and social environment in 2010).

The impacts of the simplifying assumptions and the crude contingent liability analysis are explored through sensitivity analyses. The drawbacks of the approach include the fact that the current approach does not take into account the geographical focus of PSNP, as well as the fact that the analysis did not provide



current best estimates of poverty (since household survey data from 2010/11 was used). Furthermore there is no consideration given to political concerns of government or partners. However, the sensitivity analysis shows that the key findings do not materially depend on the precise rules for defining or scaling the PSNP.

## Annex 3 – Assumptions

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Economic assumptions used in the analysis are as follows:

- > Interest rate charged on amounts borrowed: This is set equal to the yield at issue date on Ethiopian government bonds of 6.625% (issued in April 2014 in USD, the most recent such issue).
- > Investment return earned on amounts not used to fund costs: This is assumed to be 3.625%, i.e. the borrowing rate minus a spread of 3% to reflect returns on low risk investment. This is chosen to illustrate that a spread exists between the borrowing and investment rate, and sensitivity analysis is included on this assumption given the uncertainty of the quantum of this spread.
- > Government discount rate: This is set equal to the borrowing rate (6.625%).

Other financial assumptions required for the analysis are as follows:

- > Government or donor hurdle rate for budget reallocations: This is assumed to be 10%, although research has been inconclusive.
- > Delay factor for HRD response: This is the impact on benefit costs due to a delay in providing response (e.g. due to reliance on slow financing instruments such as HRD). Currently this is assumed to be equivalent to a factor of 2, such that US\$1 early (fast scaling up of PSNP) is equivalent to US\$2 late (HRD-financed).
  - Two studies estimate a delay factor of approximately 3.0 (Cabot Venton et al., 2012 and Clarke and Hill, 2012). This paper uses a delay factor of 2.0 to reflect the fact that HRD financing incurs a greater opportunity cost than other financing instruments, but to ensure the effect is not over-stated.
- > Insurance payouts: The insurance has been structured such that it starts to pay out once the federal contingency budget has been exhausted, i.e. when scale-up payments exceed the FCB of US\$50 million, insurance payouts start to be received. There is an upper limit on the insurance payout such that the total insurance payout will not exceed the amount of 1 in 30 year scale-up payments (the exhaustion point). It is assumed that 100% of the payments between the FCB and the exhaustion point are covered by the insurance.
  - In practice, the government may not be able to secure insurance coverage that is expected to pay out so frequently (the attachment point of US\$50m represents payouts in 4 out of 5 years) or with such magnitude (the 1-in-30 year loss requiring a payout of \$US405m).
- > Insurance premium: The insurance premium is determined based on the average insurance payout and an assumed insurance pricing multiple of 1.35.

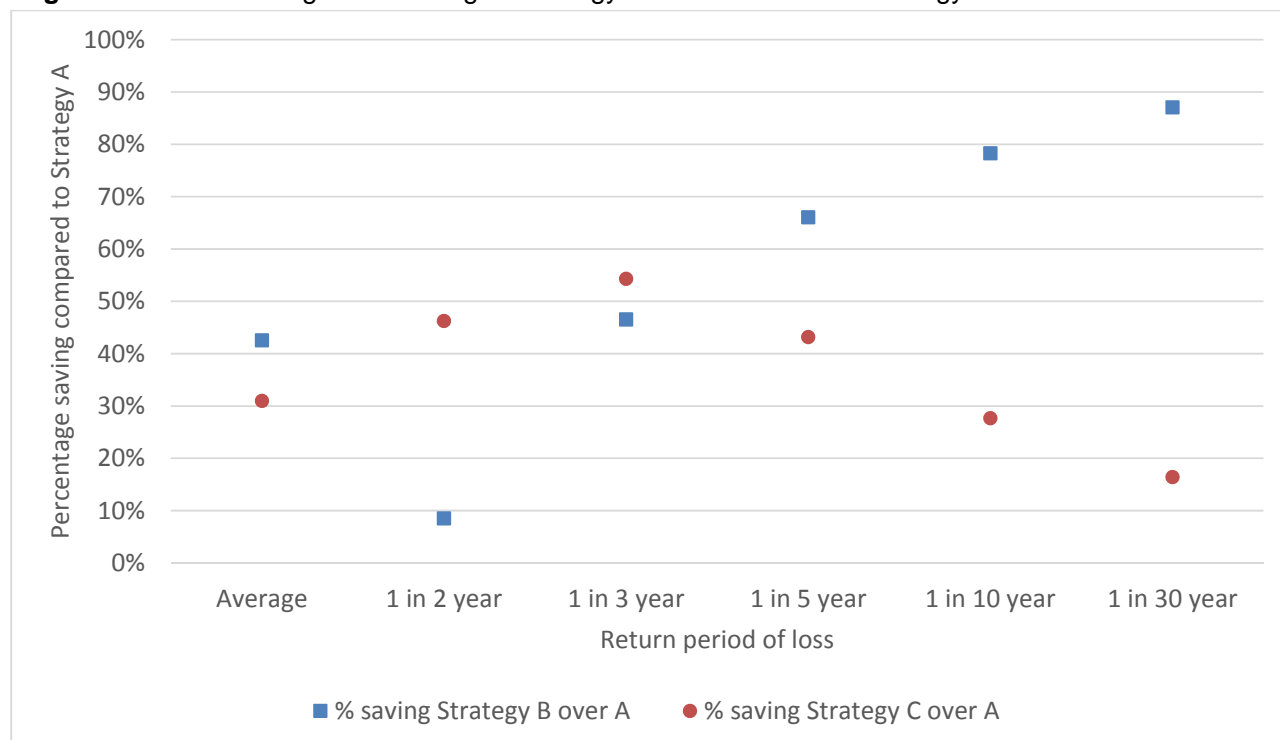
A wide range of sensitivity analyses were run to test the robustness of the results to variation in the assumptions made. The sensitivity analyses undertaken are summarised in the table below and the results are outlined in Annexes 5 and 6.

Assumption	Base Parameter	Sensitivity analysis	Reference
Spread between interest rate & investment return	3% (interest rate = 6.625%; investment return = 3.625%)	Increase the spread from 3% to 5% Decrease the spread from 3% to 1%	Annex 5 Figure A5.2
Spread between interest rate & discount rate	0% (interest rate = 6.625%; discount rate = 6.625%)	Not considered; impact would be similar to spread between interest rate and investment return. Increasing spread would minimally increase FCB and budget allocation cost only and consistently in all strategies.	
Rate of return on foregone investments when use post-disaster budget reallocation (Hurdle rate)	10%	Increase the hurdle rate from 10% to 20% Increase the hurdle rate from 10% to 40%	Annex 5 Figure A5.3
Delay factor	2 (US\$1 now = US\$2 post-event)	Increase the delay factor from 2 to 3. Reduce the delay factor from 2 to 1.5	Annex 5 Figure A5.3
Insurance pricing multiple	1.35	Increase the insurance pricing multiple from 1.35 to 1.75	Annex 5 Figure A5.2
Budget Reallocation available	US\$100 million	Not considered as this is unlikely to be greater than US\$100 million, and decreasing the amount available does not produce any new insights.	
FCB available	US\$50 million	Increase amount available to the average annual contingent liability (average annual scale-up payments) of US\$132 million	Annex 6 Figure A6.5
Magnitude of contingent liability	Distribution as defined in Annex 1	Increase the contingent liability by 25% Reduce the contingent liability by 25%	Annex 6 Figure A6.1 - A6.2

## Annex 4 – Base case: variability in the risk financing strategies

Figure A4.1 demonstrates the percentage savings of Strategy B and C over Strategy A, based on total scale-up expenditure at various increasing return periods (decreasing event frequencies).

**Figure A4.1:** Percentage cost saving of Strategy B and C relative to Strategy A



- > In the 5,000 simulations, Strategy B is more cost-effective than Strategy A 52% of the time. The insurance pricing multiple is lower than the HRD delay factor multiple and this has a material effect on the cost. At higher return periods, as the contingent liability increases, Strategy B becomes significantly more cost-effective than A due to the effect of the risk transfer, as insurance begins paying out scale-up expenditure greater than the amount charged as an insurance premium.
- > In the 5,000 simulations, Strategy C is significantly more cost-effective than Strategy A 78% of the time (with the other 22% of the time the costs being equal). This is because budget reallocation included in Strategy C is always more cost effective than HRD response. The percentage savings are greater when the contingent liability is lower (i.e. at low return periods) due to a lesser need to use HRD resources in Strategy C compared to Strategy A. The percentage cost savings over Strategy A declines as the proportion of the contingent liability financed through HRD resources increases. The simulations where the two costs are equal are where budget reallocation is never triggered, and all scale-up expenditure is covered through the FCB.

### Cumulative density function

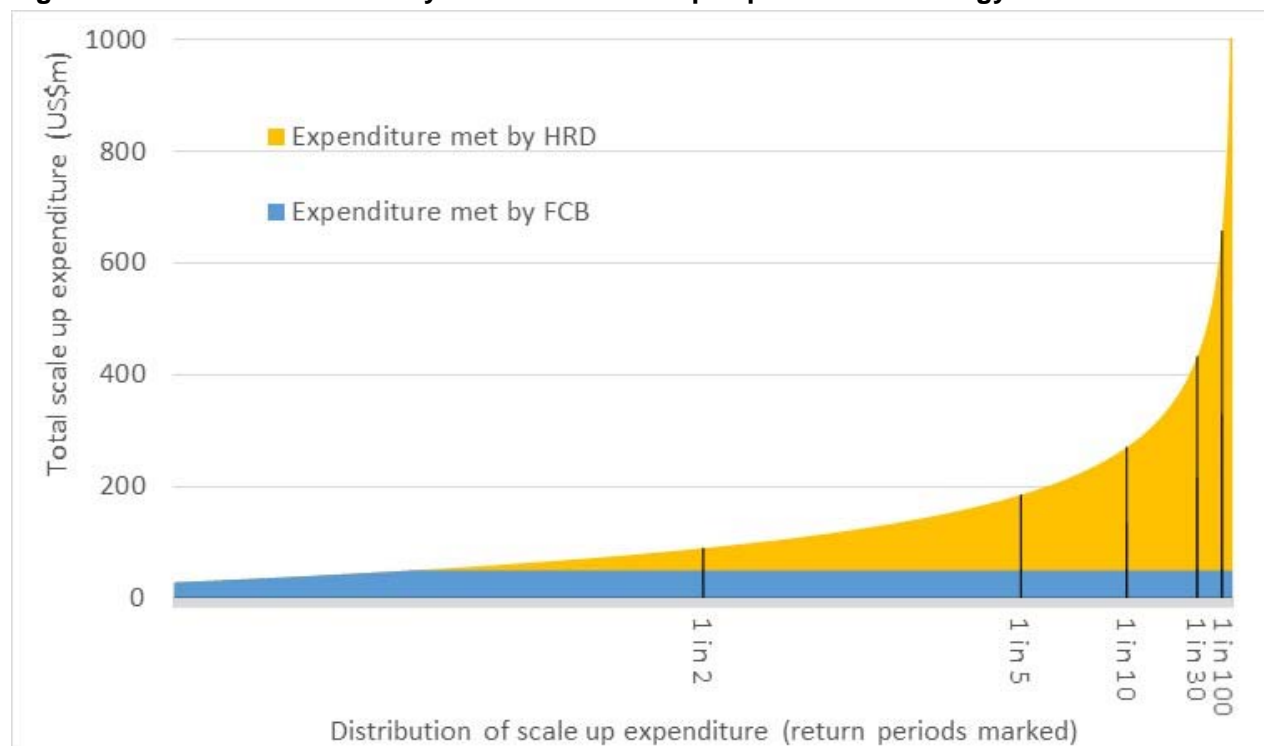
The total costs for each strategy are driven by what element or proportion of the total scale-up expenditure is financed by each financing instrument. To demonstrate how this scale-up expenditure can vary across a spectrum of probabilities, Figures A4.2, A4.3, and A4.4 demonstrate the cumulative density function of the scale-up expenditure.

This cumulative density function is based on 5,000 simulations from the fitted Pareto distribution as outlined in Annex 1. As the cumulative probability and the return period increases along the x-axis, the total scale-up expenditure increases – some key return periods are marked in the figures. It is important to note that this is a distribution of the overall scale-up expenditure and **not** the costs of financing the expenditure.

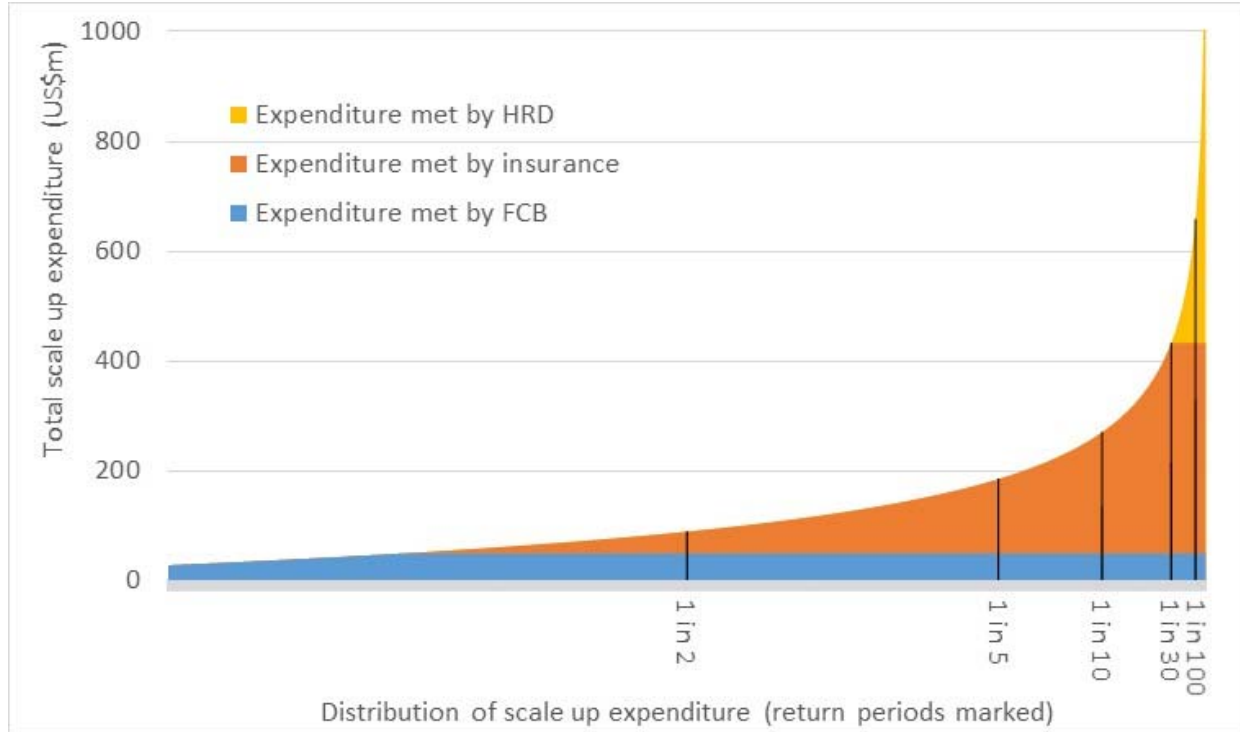
The figures also demonstrate a breakdown of which financing instruments the expenditure would be financed by. For example:

- Figure A4.2 demonstrates that FCB finances up to the 1 in 1.3 year loss.
- Figure A4.3 demonstrates that insurance finances up to the 1 in 30 year loss, as defined.
- Figure A4.4 demonstrates that budget reallocation finances up to the 1 in 3.6 year loss.

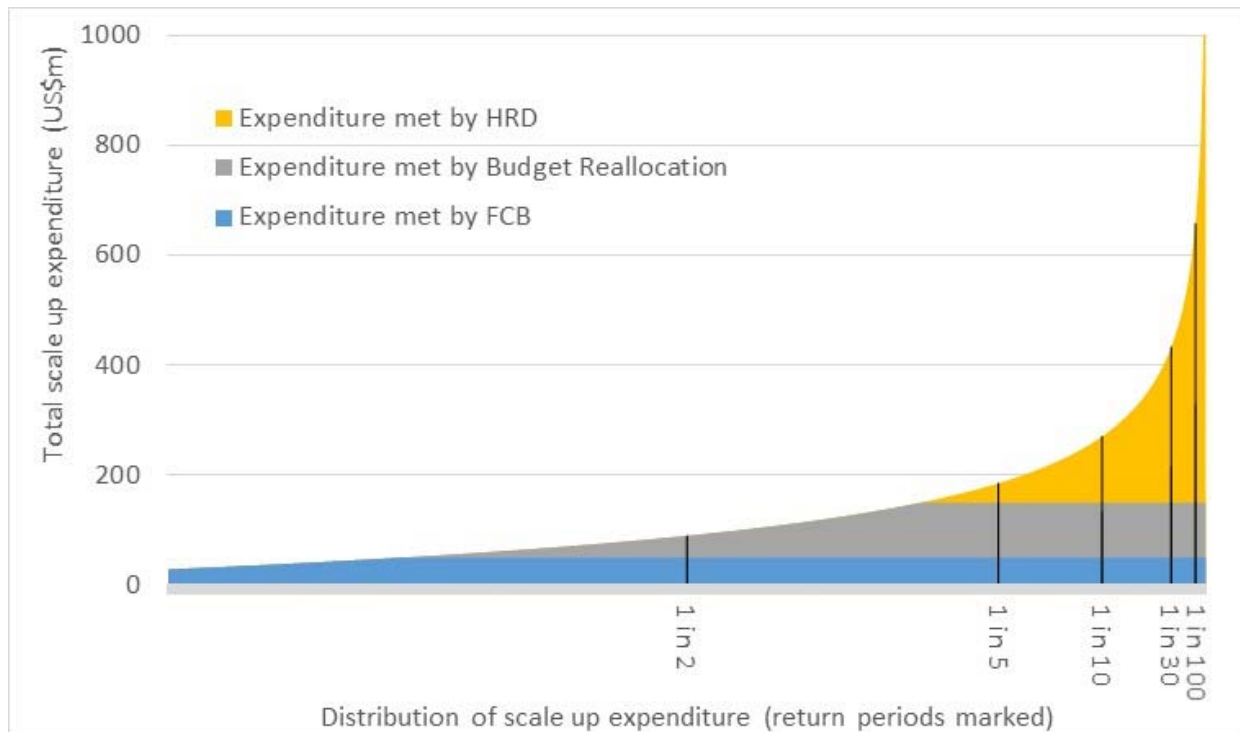
**Figure A4.2 - Cumulative density function of scale-up expenditure - Strategy A**



**Figure A4.3 - Cumulative density function of scale-up expenditure - Strategy B**



**Figure A4.4 - Cumulative density function of scale-up expenditure - Strategy C**



## Annex 5 – Sensitivity analysis: economic and financial assumptions

The following graphs consider the impact on the marginal cost of adjusting the following economic and financial assumptions:

- > The spread on the FCB and insurance multiple (Figure A5.2); and
- > The HRD delay factor and the budget reallocation hurdle rate (Figure A5.3).

**Figure A5.2: Marginal cost as a multiple of scale-up expenditure – sensitivity analysis of varying economic assumptions**

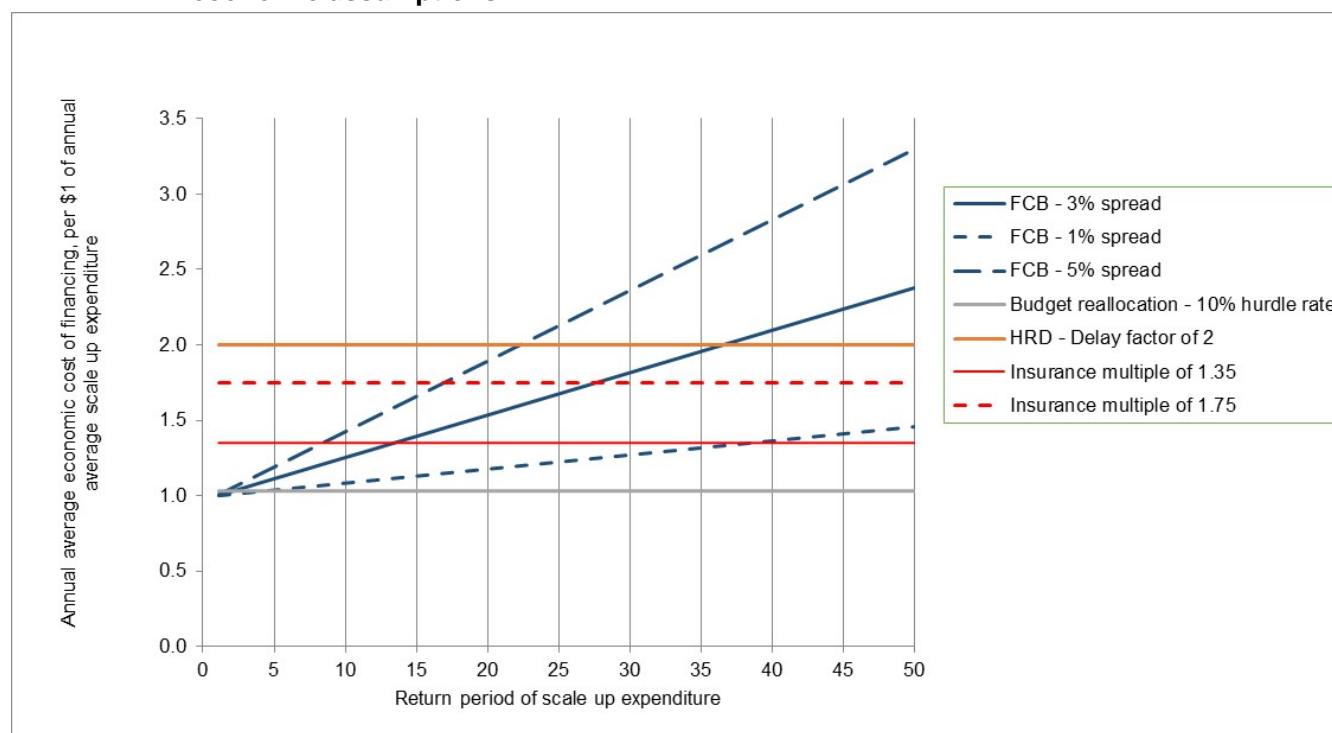


Figure A5.2 demonstrates the following intuition:

- > Increasing the spread between the interest rate and investment return of the FCB increases the slope of the marginal cost line, such that the FCB becomes less cost effective. Compared to insurance with a 1.35 pricing multiple, FCB with a spread of 5% is only cheaper up to the 1 in 8 year return periods.
- > Decreasing the spread between the interest rate and the investment return to 1% has the opposite effect – under this assumption FCB is cheaper than insurance (1.35 multiple) up to the 1 in 38 year return period.
- > Increasing the insurance multiple increases the marginal cost of insurance.

**Figure A5.3: Marginal cost as a multiple of scale-up expenditure – sensitivity analysis of varying economic assumptions**

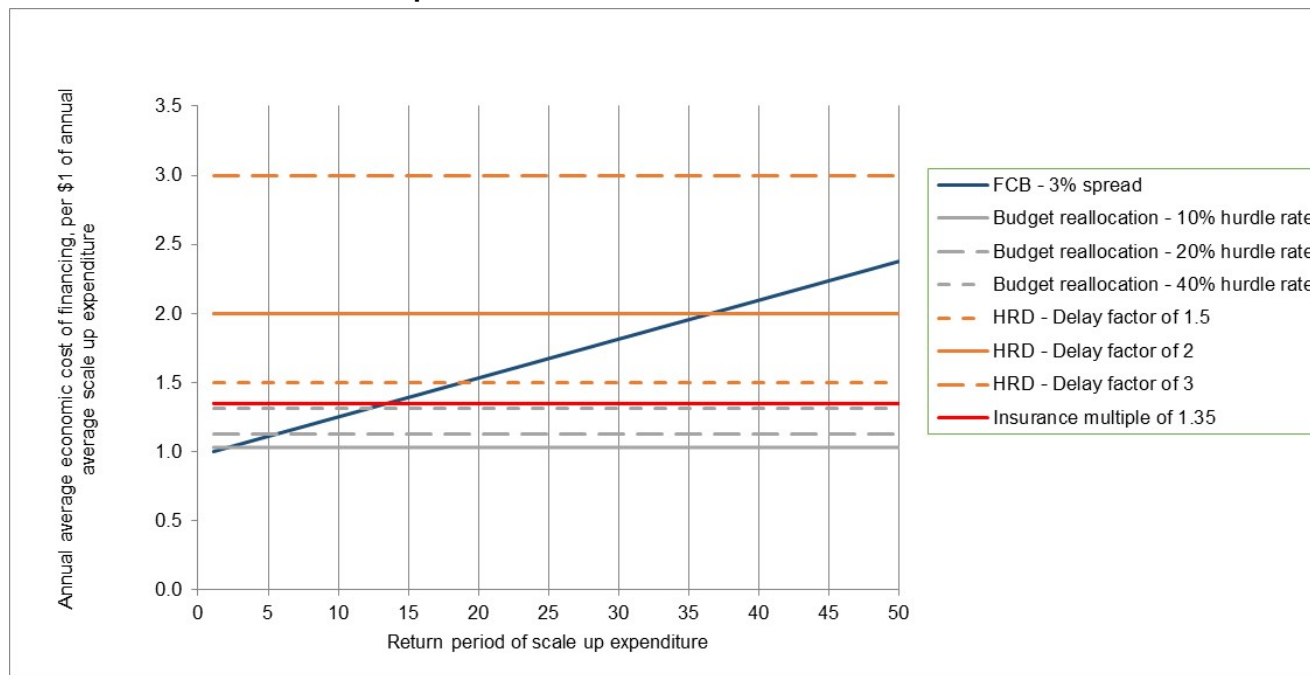


Figure A5.3 demonstrates the following intuition:

- > Decreasing the HRD delay factor decreases the cost of HRD such that it is not always the most expensive, and is cheaper than FCB at return periods of beyond 1 in 18. It is also more comparable to the marginal cost of insurance, or to budget reallocation at a higher hurdle rate.
- > Increasing the hurdle rate of budget reallocation increases its marginal cost. However even a material increase in hurdle rate from 10% to 40% results in budget reallocation still being cheaper than insurance and HRD.

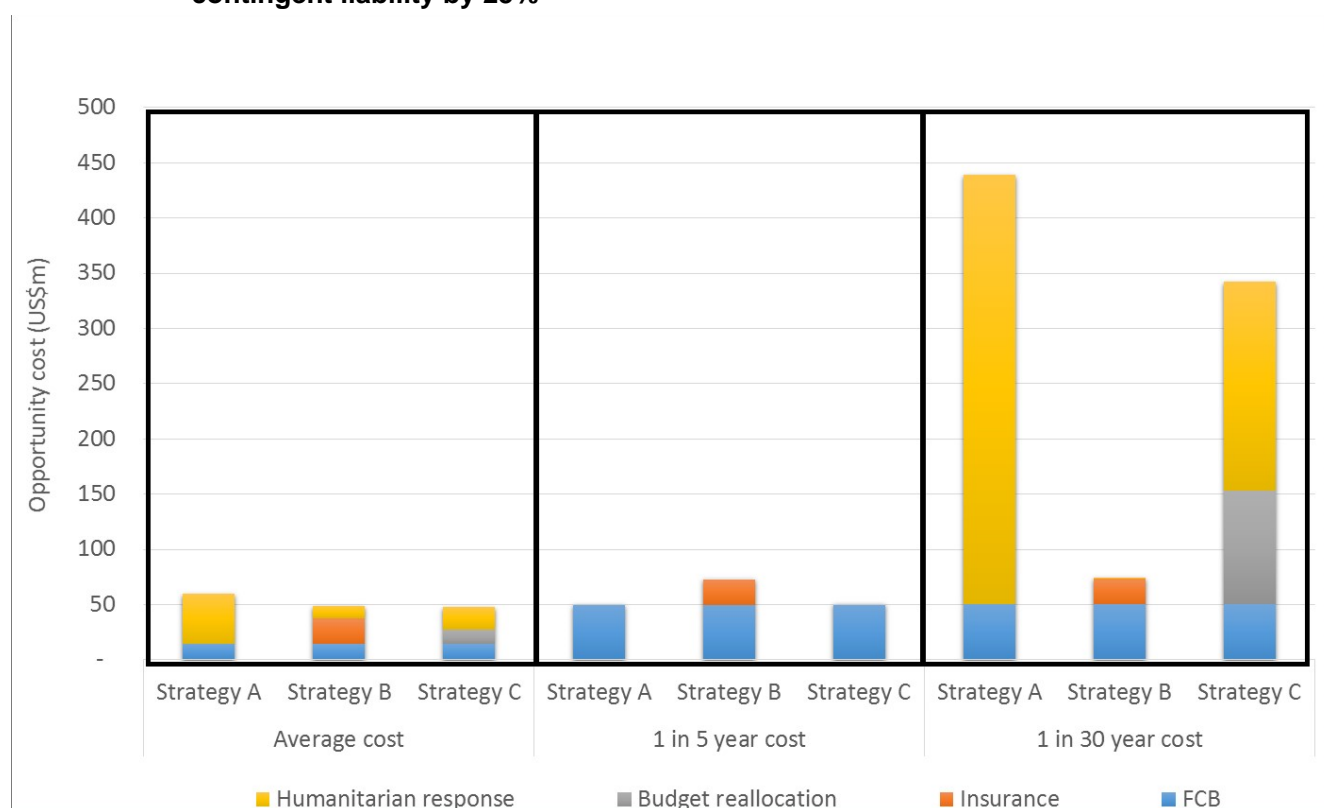


## Annex 6 – Sensitivity Analysis: Contingent Liability and Amount of Available Funds

### Varying the Contingent Liability

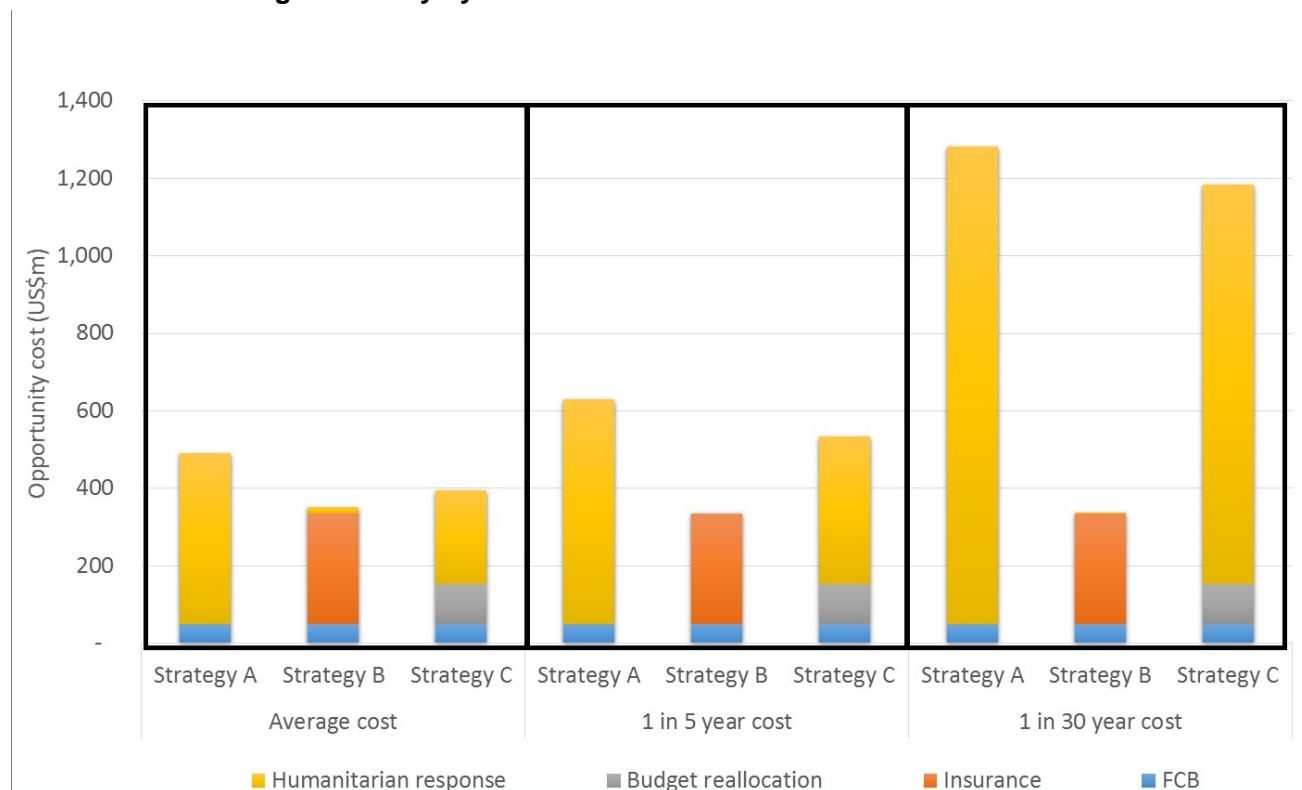
The following charts demonstrate the outcome of the cost calculations if the magnitude of the PSNP scale-up expenditure (the entire contingent liability distribution) was varied. Figure A6.1 and Figure A6.2 demonstrate the total cost of financing the scale-up expenditure for each strategy if the contingent liability was decreased or increased by 25% respectively.

**Figure A6.1: Cost of financing the scale-up expenditure by Strategy A, B and C – decreasing the contingent liability by 25%**



- > A lower contingent liability would result in the FCB being depleted less frequently (assuming FCB was held constant at US\$50 million), and insurance payments being triggered less frequently. Therefore, in the 1 in 5 year return periods, Strategy B becomes more expensive.
- > On average, Strategy B still remains slightly cheaper than Strategy C, though by a smaller proportion than in the base case scenario. This is because on average, the insurance premium also decreases (as insurance payments are triggered less frequently).
- > At severe losses like the 1 in 30 year return periods, Strategy B still remains the most cost effective.

**Figure A6.2: Cost of financing the scale-up expenditure by Strategy A, B and C – increasing the contingent liability by 25%**



- > In the 5,000 simulations for this scenario, Strategy B and Strategy C are both more cost-effective than Strategy A 100% of the time. This is because the significant size of the contingent liability always triggers a requirement for funds beyond the amount of available FCB.
- > Compared to the base case scenario, the percentage savings from Strategy B over Strategy A are significantly higher because insurance payouts are triggered more frequently. In this sensitivity scenario the insurance premium is higher due to more expected losses covered by the insurance contract (the 1 in 30 year scale-up expenditure is US\$666m compared to US\$455m in the base case scenario). However, Strategy B is still significantly more cost effective than Strategy A, due to the fact that the insurance multiple of 1.35 is smaller than the HRD delay cost multiple of 2.0.
- > Strategy C remains more cost effective than Strategy A for all return periods and on average. However, savings from Strategy C over Strategy A are lower than in the base case because the effect of the lower-cost budget reallocation has a comparatively smaller impact as a proportion of the total cost.

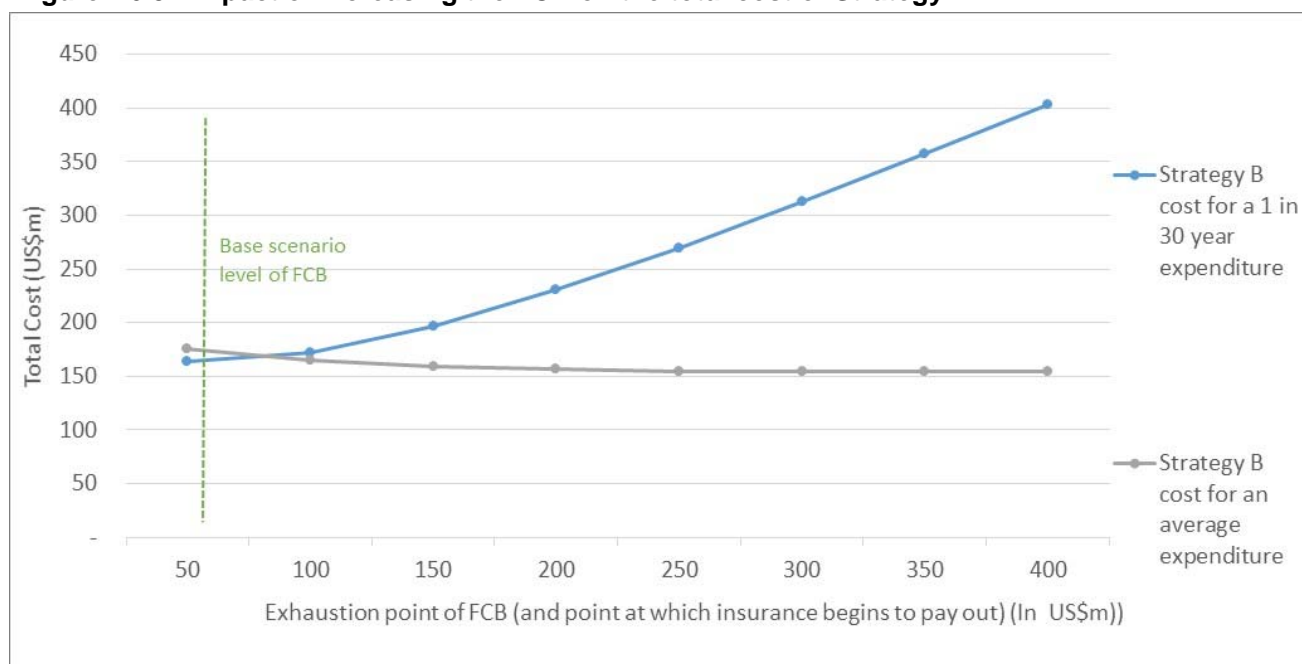
### Varying the FCB

The sensitivity analysis looked at the cost of Strategy B if the size of the FCB (and hence the point at which insurance starts to pay out) is increased. The maximum insurance exhaustion point was kept fixed (i.e. the total payments covered by insurance was reduced).

Figure A6.3 shows the impact of increasing the amount of available FCB and the corresponding point at which insurance starts to pay out. The average cost decreases (slowly) as the amount of available FCB increases – see the green line in Figure A6.3. However, the cost increases for less frequent and higher contingent liabilities when the amount of available FCB increases (and the payments available from insurance decrease) – see the blue line in Figure A6.3.

- > The cost of financing a 1 in 30 year contingent liability increases significantly as the size of the potential insurance payout diminishes, since the assumed insurance coverage is significantly more cost-effective at the 30 year return period.
- > The cost of financing the average contingent liability decreases, due to the decreasing insurance layer and premium costs.

**Figure A6.3: Impact of increasing the FCB on the total cost of Strategy B**



## Multi-year Analysis

A multi-year analysis was considered in which the unused portion of the FCB was assumed to roll forward to future years, with all other assumptions being kept the same as in the base case scenario.

In the base case scenario the funds available from the FCB are often fully utilized and therefore do not rollover to future years, hence the total costs over a 5 year time period are not significantly different to the total costs over a 5 year period in the base case scenario.

If the amount of available FCB was much larger such that it does not exhaust frequently (e.g. if an FCB of US\$132 million, equal to the average contingent liability, was held) and the unused portion of FCB is allowed to roll over from one year to the next, then there would be a lower cost in all strategies over a five year time period relative to a five year time period in the base case scenario. This is because, on average, there would be access to more FCB funds (with a lower cost than HRD) in a multi-year time horizon than on a one-year term where any unused FCB would be lost.