Government Actuary's Department

Department for Transport

Airline Insolvency Review – Risk Analysis Phase 2

Date: 8 February 2019

Author: Chris Paterson FIA
Jack Carroll FIA

Contents

1 Executive Summary 3
- Distribution of cost of repatriation 3
- Cost of policy options 4

2 Scope of work 6

3 Data 7

4 Policy Options 8

5 Methodology 10
- Insolvency probabilities for airlines 10
- Approaches for calculating insolvency probability 11
- Estimate of distribution of cost of protection 12
  1. Determining if and when each airline becomes insolvent 13
  2. Determining the number of passengers for repatriation 14
  3. Determining the method of repatriation 14
  4. Estimating the cost of repatriation 15
  5. Allowing for existing protections 15
  6. Constructing the cost distribution 15
  7. Allocating the cost 15

6 Results – Overall distribution and sensitivity 18

7 Results – Cost of policy options 26
- Estimating insurance premiums 26
- Estimating levies and fund sizes 26
- Estimating cost of providing security 27
- Option S1 –Security and Government Reinsurance 33
- Option S2 –Security, Levy Fund, and Government Reinsurance 33
- Option S3 –Security, Levy Fund, Commercial and Government Reinsurance 35
- Option S4 – Levy Fund, Commercial Reinsurance, and Government Reinsurance 35
- Option S5 – Levy Fund and Government Reinsurance 35

8 Limitations and professional compliance 39

Appendix A: Data used 40

Appendix B: Monte Carlo Simulations 41

Appendix C: Assumptions 42
- Data accuracy 42
- Correlations 42
- Calculating indicative insurance premiums 42

Appendix D: Option S3 examples 44

1 Executive Summary

1.1 The purpose of this report is to provide estimates of the cost of providing repatriation to the UK of passengers affected in the event of an airline insolvency. This report has been prepared by GAD for the Airline Insolvency Review (the Review). We have been asked by the Review to analyse the cost of repatriations only, and not refunds for passengers who have yet to travel.

1.2 In order to estimate the cost of repatriation we have used data provided by ICF drawn from a variety of industry sources. This data is described in their report: ICF, Airline Insolvency Review: Aviation Data & Economics. ICF is a global professional, technology, and marketing services firm who advise on aviation issues and have been contracted by the Review to provide this data. The data includes insolvency risk of major airlines serving the UK, flight data and detailed cost information setting out the cost of repatriating passengers.

1.3 This report has been published alongside the report of the Review and should be read in that context. It should also be read in the context of the limitations and professional compliance set out in Section 8 of this report.

Distribution of cost of repatriation

1.4 We have estimated the distribution of the annual cost of repatriating passengers[1] due to airline insolvencies. This distribution allows us to answer questions such as:

> How much should I expect to pay to be able to repatriate passengers affected by airline insolvencies?

> What is the chance of the cost of repatriation in one year exceeding £10m, or £50m, or £100m?

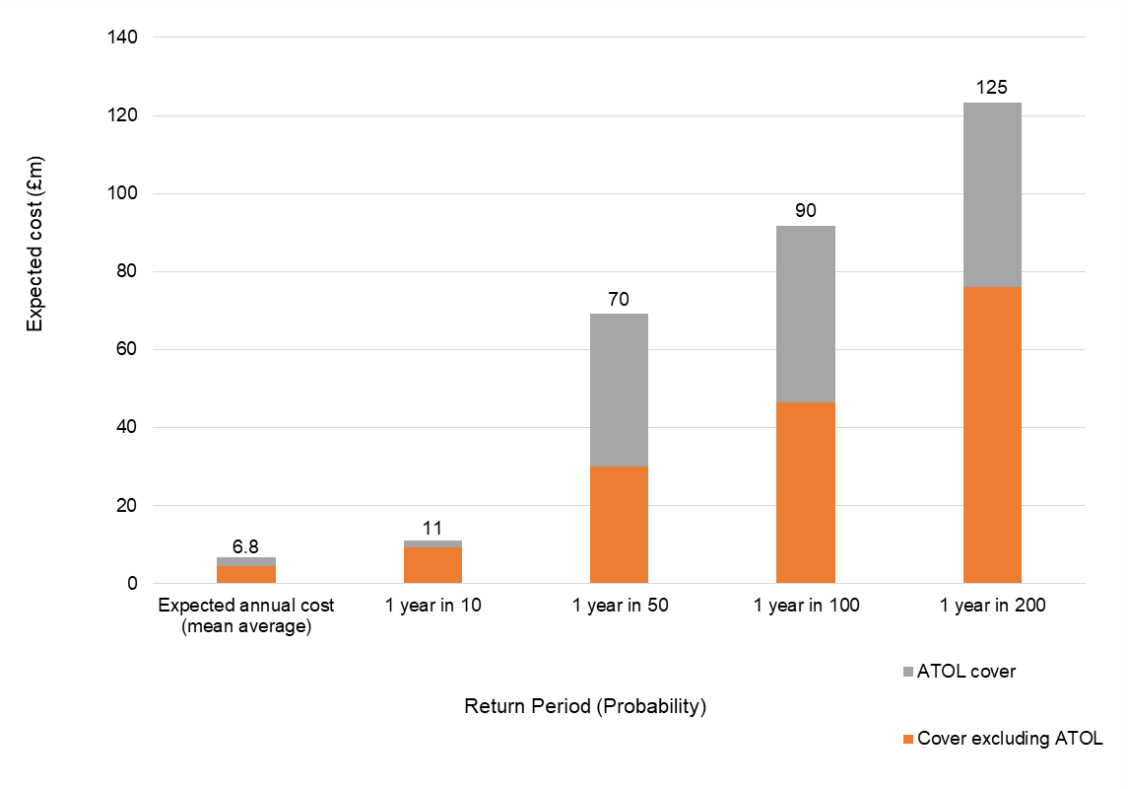
It also allows us to estimate the costs of different financial options for covering this cost by building up a fund or by buying insurance.

1.5 Some of these costs will be covered by existing passenger protections such as some travel insurance policies, card payment protections, and the Air Travel Organiser's Licence (ATOL) Scheme. Our analysis looks at the total cost but we have also included estimates of how much this cost would reduce if the ATOL scheme paid for repatriation costs where that cover is in place.

1.6 Chart 1.1 shows the distribution of the cost of repatriation – i.e. the cost at a variety of return periods, or probabilities. The chart includes the total costs of repatriating all passengers and the costs excluding those which would be covered by the ATOL scheme.

[1] Passengers to be repatriated are defined by the Review as "Passengers who took an outbound flight from the UK, and have a ticket to return to the UK on the failed airline."

Chart 1.1 – Expected cost of providing repatriation cover in the case of airline insolvency at different return periods (probabilities) – with and without ATOL



1.7 **The expected (mean average) cost to repatriate passengers is £6.8m per year and there is a chance that this cost in one year could be higher or lower than this.** For example we can see that there is a 1 in 50[2] (or 2%) chance of a cost of c£70m or more. Another way of looking at this is to say that if we looked at fifty years of repatriation costs we would expect the cost to be larger than £70m in only one of those years.

1.8 The estimate of this range of cost depends heavily on the assumptions we have made and the data used. For example if we assume that the airlines have a much greater probability of insolvency the costs would be much larger.

Cost of policy options

1.9 The Review has set out a range of policy options. Each of these is designed to fund all of the repatriation cost. To do this they use a mix of:

> **Insurance and reinsurance**: This is either

- airlines buying insurance directly to pay for repatriations on their insolvency, or
- a repatriation body which only covers repatriation costs up to a limit each year and buys reinsurance to pay out any costs in excess of this limit.

[2] A 1 in X year event indicates that the event would only be expected to occur once every X years. For example a 1 in 100 event means that event is only expected once every 100 years.

- **Security over airlines**: Airlines purchase security such as a letter of credit or a bond from a bank or other provider. If the airline becomes insolvent this security pays out to repatriate the airline's passengers.
- **Levies charged to build up a fund**: Airlines pay a levy to a repatriation body which uses the levies to maintain a fund. On insolvency of an airline the fund can be used to pay for repatriation of passengers.

1.10 **There is a wide range of cost of these options. We have estimated the annual ongoing cost of these options range from c£8m per year to c£44m per year.** The wide range of costs arise from two main factors:

- **Where an insurer covers all airlines together (the risk is pooled) the cost is reduced**. This is due to two main reasons:
  - One component of the cost of insurance is a cost of capital which is a regulatory requirement and represents the cost of holding capital to be able to pay the costs of a 1 in 200 event. If each airline uses a separate insurer, each insurer needs to hold this capital and charge a cost of capital for doing so. If one insurer covers all airlines it can achieve economies of scale as it can use the same capital to cover the risk of more than one airline. It can therefore charge a lower cost of capital.
  - In this comparison there are also economies of scale savings for costs for administering the insurance.
- **Once the fund is built up, the cost of using a levy fund is cheaper, but it costs money to build it up.** The options with the lowest ongoing costs charge levies to airlines to maintain a levy fund to pay for repatriation. These are the lowest cost options because:
  - The ongoing cost doesn't allow for a cost for building up the fund in the first place. We have illustrated this cost with some examples where building up the fund over 5 years can increase the total annual cost in that period by 2 to 4 times.
  - They don't charge for the opportunity cost of holding the fund monies whereas our estimates for costs of insurance options effectively do this through charging a cost of capital.

1.11 **If the cost of cover per passenger is paid by airlines based on the cost of each airline's individual risk the riskiest airline pays hundreds of times more per passenger than the least risky airline.** We have also estimated the costs of these options charged to airlines on a "per passenger" basis. This adds additional variation into the cost due to two main factors:

- **Airlines with higher chance of insolvency pay more per passenger.**
- **Airlines with higher costs of repatriation pay more per passenger.**

2 Scope of work

2.1 This report has been prepared by the Government Actuary's Department (GAD) at the request of the independently chaired Airline Insolvency Review (the Review), within DfT. The purpose of the report is to provide estimates of the distribution of costs of providing repatriation of passengers requiring repatriation to the UK following an airline insolvency. In addition to this a number of policy options have been set out by the Review and this report is intended to estimate indicative costs to airlines of paying for those policy options, including estimates of the cost of:

- Levies paid to build up funds to pay for repatriation
- Insurance premiums for insurance to pay for repatriation
- Security costs for providing security to pay out on airline insolvency.

2.2 The analysis in this report is based on data provided by ICF derived from a number of sources. We have carried out checks on this data as far as is practicable including comparing results with our analysis contained in our report dated June 2018. However the analysis relies on the accuracy of the data from ICF.

2.3 The methodology and assumptions used are also set out in the report.

3 Data

3.1 Appendix A gives more information on the data used and the checks we have carried out on the data and adjustments we have made to it. The majority of the data used has been provided by ICF. This data is described in their report: ICF, Airline Insolvency Review: Aviation Data & Economics. ICF is a global professional, technology, and marketing services firm who advise on aviation issues and have been contracted by the Review to provide this data.

3.2 We have also used data from Moody's and S&P relating to credit ratings and insolvency probabilities.

3.3 A summary of the data used is shown in Table 3.1. We have used data for 2018. As data for the whole of 2018 was not yet available when ICF provided the data, this consists of actual data for the first part of 2018, and projected data for the remainder of 2018 based on data from 2017 projected forward allowing for growth.

Table 3.1 – Data summary – 2018

Airlines[3]	Number of plane departures from UK	Total daily average repatriation cost exposure	Average airline ATOL cover, weighted by exposure	Average credit card / SAFI cover, weighted by exposure[4]	Average proportion of uncovered passengers	Average insolvency probability, weighted by exposure
	Number per year	£m per day All cover	%	%	%	%
Individually modelled airlines	851,082	1,214	24.9	75.0	18.5	0.52
Collectively modelled airlines	103,987	52	24.9	75.0	21.2	1.45

3.4 When using passenger numbers for calculating "per passenger" costs we have used the numbers provided by ICF for outbound UK resident passengers excluding those who are transferring. This comes to a total of 81m in 2018. This is not an exact match to the Review's definition of passengers to be repatriated which is: Passengers who took an outbound flight from the UK, and have a ticket to return to the UK on the failed airline. However this data is the closest to the definition that was available in the data provided. The differences in these populations will consist of:

- Outbound UK residents without a return ticket are included in the data used but not the Review's definition
- Outbound non-UK residents with return tickets are included in the Review's definition but not the data used.

[3] These categories are defined in paragraph 5.4
[4] The cover of ATOL and credit card / SAFI overlaps – e.g. 75% of passengers who have ATOL cover are assumed to have other cover from credit card protection or SAFI.
SAFI is Scheduled Airline Failure Insurance.

4 Policy Options

4.1 The Review is assessing a range of policy options for providing protection. For estimating costs we have looked at two sets of options:

> Shortlisted Options – a set of high level options for providing repatriation cover.

> Structuring Options – a more defined set of options for providing repatriation cover, set out following discussions with financial market stakeholders.

4.2 These are described in more detail in the following tables. We have not considered factors affecting the feasibility of these options as these are being considered separately by the Review.

Table 4.1 - Shortlisted Options

No.	Name	Description	Features
Airline Seat Levy options			
C1	Flat Levy	All airlines levied a flat surcharge per passenger. Levies paid to a fund assigned to a coordinating authority to pay out on airline insolvency.	Funded Partially risk-based (through passenger numbers) Claims in excess of fund need to be taken by insurer or government
C2	Risk-Based Levy	As C1 with levy risk-based, based on passenger numbers and insolvency risk of airline.	Funded Fully risk-based Claims in excess of fund need to be taken by insurer or government
C3	Variable Levy	As C1 with two options for airlines: 1. Pay a levy as per C1 2. Provide security fitting a set of criteria which would provide repatriation cover on airline insolvency	Partially funded Partially risk-based (through passenger numbers and security pricing) Risk partially pooled Claims in excess of fund taken by insurer or government Choice for airlines
Security package option			
E	Airline Security Package	Airlines mandated to provide security fitting a set of criteria which would provide repatriation cover on airline insolvency	Unfunded Risk-based Risk not pooled (as all airlines seeking individual security)

Table 4.2 – Structuring Options

No.	Name	Description	Features
S1	Security and Government Reinsurance	Airlines mandated to provide security up to a limit, fitting a set of criteria which would provide repatriation cover on airline insolvency. Claims in excess of this limit covered by reinsurance provided by government.	Unfunded Risk-based Risk not pooled (as all airlines seeking individual security) Claims in excess of security taken by government
S2	Security, Levy Fund, and Government Reinsurance	Airlines mandated to provide security up to an airline-specific limit[5], fitting a set of criteria which would provide repatriation cover on airline insolvency. Claims in excess of this limit covered by a levy fund up to a second overall limit. Claims in excess of the overall limit covered by reinsurance provided by government.	Partially funded Partially risk-based (through passenger numbers and security pricing) Risk partially pooled Claims in excess of fund taken by government
S3	Security, Levy Fund, Commercial Reinsurance, and Government Reinsurance	Airlines mandated to provide security up to an airline-specific limit[5], fitting a set of criteria which would provide repatriation cover on airline insolvency. Claims in excess of this limit covered by a levy fund up to a second lower overall limit. Claims in excess of the second lower overall limit are covered by commercial reinsurance up to a third higher overall limit. Claims in excess of the higher overall limit covered by reinsurance provided by government.	Partially funded Partially risk-based (through passenger numbers and security pricing) Risk partially pooled Claims in excess of fund taken by commercial insurer and government
S4	Levy Fund, Commercial Reinsurance, and Government Reinsurance	All airlines levied a flat surcharge per passenger. Levies paid to a fund assigned to a coordinating authority to pay out on airline insolvency. Claims in excess of the fund covered by commercial reinsurance up to a limit. Claims in excess of the limit covered by reinsurance provided by government.	Funded Partially risk-based (through passenger numbers) Claims in excess of fund need to be taken by insurer and government
S5	Levy Fund and Government Reinsurance	All airlines levied a flat surcharge per passenger. Levies paid to a fund assigned to a coordinating authority to pay out on airline insolvency. Claims in excess of the fund covered by reinsurance provided by government.	Funded Partially risk-based (through passenger numbers) Claims in excess of fund need to be taken by government

[5] This airline specific limit is set with reference to the likely claim amounts in the event that insolvency occurs, e.g. 50% of the likely claim amount.

5 Methodology

5.1 The purpose of this report is to provide estimates of the cost of providing repatriations in the case of airline insolvency, and to estimate how those costs are allocated according to the different policy options being considered. This section of the report describes how we have produced these estimates.

5.2 We have been asked by the Review to analyse the cost of repatriations only, and not refunds for passengers who have yet to travel.

5.3 There is inherent uncertainty as to whether or not each airline becomes insolvent. To reflect this we have estimated a distribution of the cost. This is different from the approach taken in our report dated 28 June 2018 where we provided estimates of the number of people affected by airline insolvency but not the distribution (or range of possible results) of this number, or the cost of providing repatriation.

5.4 All airlines serving passengers travelling to and from the UK are in scope of this review. We have divided the airlines into two large groups, one of which is then split further into subgroups:

1. **Individually modelled airlines:** The top 35 airlines, as measured by the number of passengers arriving and departing the UK, were assigned credit ratings. This equates to 93% of total UK aviation demand in 2017. We have modelled these airlines individually.

2. **Collectively modelled airlines**: The remaining 7% of airlines have been split into 20 subgroups. These subgroups have been modelled as individual airlines. These subgroups have been set up by ICF to categorise the airlines based on the following characteristics:

   - Size of airline in the UK
   - Size of airline overall
   - Dominance in home market
   - Ownership – Public or private

   These groups are typically small (between 1 and 15 airlines).

Insolvency probabilities for airlines

5.5 ICF have provided annual insolvency probabilities for each airline and group based on publicly available Moody's credit ratings of airlines. Where credit ratings are not publicly available, ICF have estimated these using the following approaches:

1. Based on Moody's published methodology, publicly available financial statements and ICF's access to industry data sources such as IATA's PaxIS and OAG, ICF were able to estimate airlines' credit ratings.

2. Use credit rated enhanced equipment trust certificates (EETCs) which reflect the seniority of debt, the airline's financial position, and the attractiveness of the airline's assets (e.g. the aircraft).

3. Comparison to publicly rated carriers. ICF have assigned credit ratings based on the most comparable publicly rated airline using factors such as network size, business model and geography.

5.6 ICF have also provided factors allowing for the variation in insolvency probability by month. For each simulation we have used these to simulate in which month an airline becomes insolvent and select the cost of repatriation in that month. Both the insolvency probability and the cost of repatriation will vary considerably over the year.

Approaches for calculating insolvency probability

5.7 ICF have used an evidence-based approach to derive the insolvency probabilities associated with each credit rating: they used industry transition tables. Transition tables record the percentage of companies with a given credit rating which went insolvent within a 12 month period.

5.8 There are alternative approaches for estimating insolvency probabilities, for example:

> We could use an alternate source of insolvency probabilities. ICF have used Moody's as the source of insolvency probabilities, and in section 6 we have looked at the impact of instead using S&P methodologies to determine the insolvency probabilities.

> Deriving insolvency probabilities from historic data on airline insolvencies. See Table 5.1 for a comparison of this approach. ICF have carried out analysis of historic airline insolvencies. We comment further on this in section 6.

Table 5.1 – Approaches to estimating insolvency probability for airlines

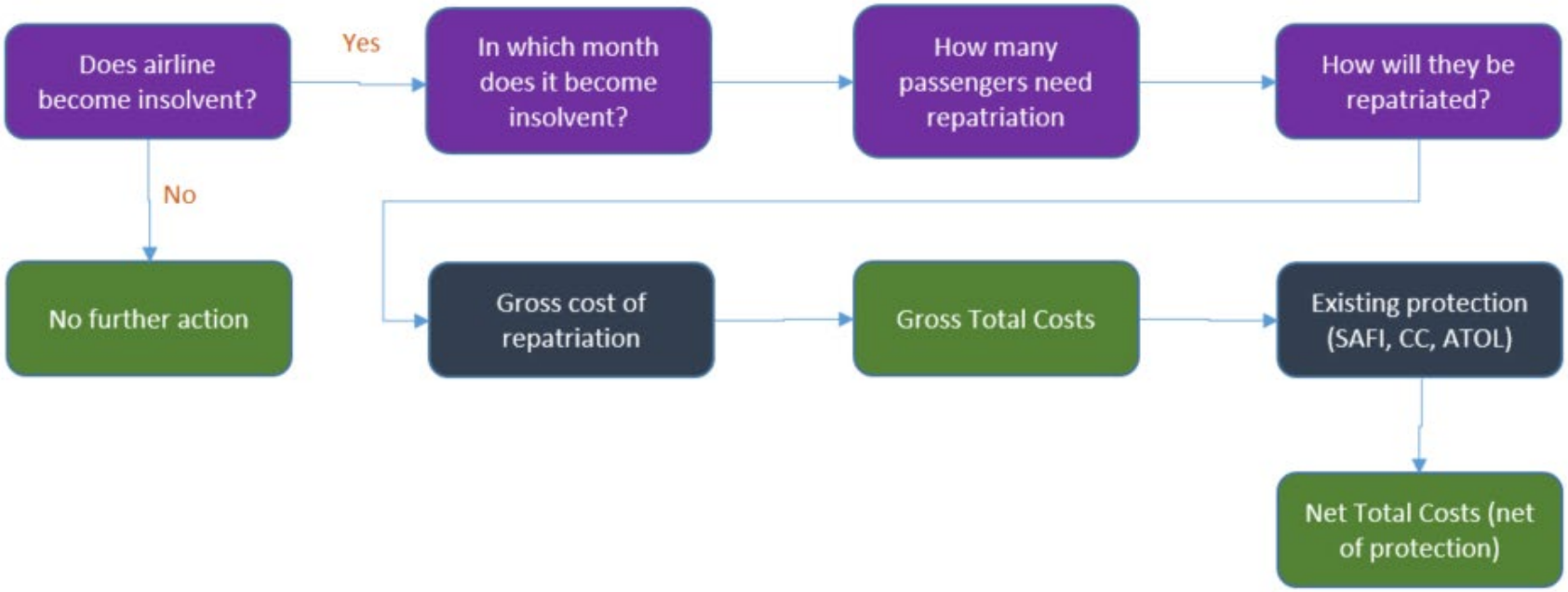
Approach	Advantages	Disadvantages
Credit rating agency probabilities	• Based on multiple years of insolvencies of rated companies globally • Publicly available probabilities • Predictive • Ratings relied upon across the financial services industry • Based on the characteristics of each airline / group • Similar to the approach used by many insurance companies	• Not airline-industry specific
Historic airline insolvency data	• Based on actual airline insolvency data	• Data is sparse • Historic, not predictive • No allowance for characteristics of airlines • Need additional work to allocate insolvency rates to individual airlines in order to calculate costs • Unlike an insurance company approach

5.9 Table 5.1 clearly shows that the approach of using probabilities derived from credit rating agencies is preferable in the context of designing and assessing repatriation protection.

Estimate of distribution of cost of protection

5.10 Figure 5.1 summarises the methodology to produce the distribution of costs:

Figure 5.1: Flowchart for estimating cost of protection



From Figure 5.1 we can break down the estimate into 7 parts:

1. Determining if and when each airline becomes insolvent

5.11 In order to estimate the cost distribution we have used a Monte Carlo simulation (see Appendix B: for further details). This involves estimating (or "simulating") the cost of one year many times over – in this case 100,000 times – and combining the answers to produce a distribution of possible costs.

Each of the simulations is varied by generating a number of random variables to use in the calculation of whether or not an airline becomes insolvent. These random variables are numbers between 0 and 1 generated at random for each scenario. The following gives an example of how this could be used:

Illustrative example

> Airline A has an insolvency probability of 0.3% in a year

> A random variable is generated between 0 and 1 for one simulation. The random variable for one specific simulation is 0.345

> The random variable is multiplied by 100 to convert it to a percentage: 0.345 x 100 = 34.5%

> If this percentage is below the insolvency probability for Airline A the airline is deemed to have become insolvent in this simulation and a cost is allocated to that insolvency for repatriation.

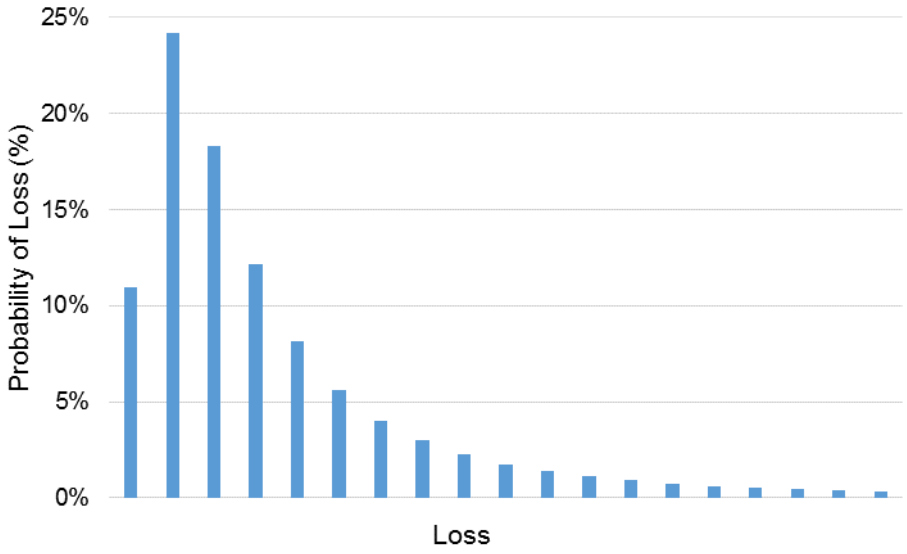
> In this case the percentage is greater than the insolvency probability (34.5% > 0.3%) so Airline A does not become insolvent in that simulation and no cost is allocated

> This is repeated until a large number (e.g. 100,000) simulations are complete. It is expected that in these simulations Airline A will become insolvent in 0.3% of them (or 300 simulations).

> In the simulations where Airline A does not become insolvent the cost will be 0, and only when the airline becomes insolvent will there be any cost.

5.12 Chart 5.1 shows an example of a loss distribution where a "low" loss is reasonably likely and there is a low likelihood of a large loss (the distribution has a long tail to the right).

Chart 5.1 Simplified example of loss distribution



5.13 In order to then estimate the cost where the airline has become insolvent we then need to estimate the number of passengers affected.

2. Determining the number of passengers for repatriation

5.14 The number of passengers for whom we estimate the cost of repatriation are defined by the review as:

> Passengers who took an outbound flight from the UK, and have a ticket to return to the UK on the failed airline.

5.15 ICF have provided data on the number of these passengers broken down by factors determining the cost of repatriation such as length of trip and airline. Using this data we can estimate how many passengers require repatriation in the month of insolvency for the airline. We estimate this in any simulation where an airline becomes insolvent.

3. Determining the method of repatriation

5.16 ICF have determined the cost of repatriation for each set of passengers based on data on the route, airline, capacity of other airlines, and charter airline availability. This has been used to select an option or combination of options for repatriation which are then costed. The options being considered in the review are:

1. Self-repatriation – Affected passengers find, book and pay for seats on other airlines on "rescue fare" terms, a discounted price for two weeks. If needed, the Coordinating Body would help with a website, sign-posting the airlines offering such fares.

2. Assisted repatriation – An operation in which the Coordinating Body plays a more active role than in Self-Repatriation by providing a central flight availability and booking facility through which passengers can select and pay for their flights.

3. Organised charter – Operation by a Coordinating Body to charter third-party aircraft capacity acquired in advance and post airline insolvency and placed into an organised substitute flying programme.

4. Keep the fleet flying (KFF) – An orderly wind-down, where the airline's (inbound) flying programme is maintained for a short period, being up to 14 days in most cases, or until the market can provide sufficient alternative capacity to meet on-going demand.

4. Estimating the cost of repatriation

5.17 The cost of repatriation by the different methods has been provided by ICF and is then applied to the numbers of passengers. Note the repatriation cost per passenger for assisted and self-repatriation are assumed to be identical.

5.18 For each simulation, each of which represents one year, the costs of repatriation for each airline that becomes insolvent in the year are added together to give a total estimated cost for that simulation.

5. Allowing for existing protections

5.19 Many passengers already travel with some protection against insolvency. In particular this protection will come in the form of ATOL, credit card protection and Scheduled Airline Failure Insurance (SAFI). There is uncertainty on how much of the total cost would be covered by credit cards and SAFI, whilst the level of protection from ATOL is clearer. Therefore, where we have estimated the costs of repatriation, we have also deducted the estimated amount of this cost covered by ATOL in order to give the estimated net cost.

6. Constructing the cost distribution

5.20 The costs for each simulation are then combined to form a distribution of cost, allowing us to understand the expected cost at different probabilities. This cost is given both with and without the protection described in paragraph 5.19.

7. Allocating the cost

5.21 Each policy option involves an allocation of cost to those paying for the cover – e.g. the airline or the passengers. We use the distribution of cost to do this. This is different for each policy option and is based on the features of that option as follows:

Illustrative Example

5.22 Airline levies per passenger are calculated by:

> Assuming a size for the levy fund, based on a level of risk for the fund to cover (e.g. a 1 in 100 year event[6]). For the purposes of the example assume that this is £10m.

[6] A 1 in X year event indicates that the fund is sufficient to pay all claims that would be expected to occur up to a level that only occurs once every X years. For example a 1 in 100 event means that the fund should suffice for all occasions except for a level of claims that is only expected once every 100 years.

> Calculate the amount of the fund that is expected to be used each year – the expected value (mean average) of the cost distribution. For the purposes of the example assume that this is £3m.

> Divide that expected value by the number of passengers covered to calculate the (non-risk based) levy. For example, if there are 100m passengers, the levy per passenger (non-risk-based) is £3m / 100m = 3p per passenger for each airline.

> If the levy is risk-based this amount would be adjusted to reflect the insolvency risk of the airline. Higher risk airlines would be charged more and vice versa.

5.23 As a simplified example of how we have allocated the levy by insolvency risk we consider a case where there are only two very large airlines:

- The total cost of repatriation cover is £10 million.
- Airline A has an insolvency risk of 0.3% and carries 10 million passengers per year
- Airline B has an insolvency risk of 1% and carries 8 million passengers per year

The amount of cover paid by each airline is weighted by number of passengers and by insolvency risk. In order to calculate it we first calculate the multiple of these two factors for each airline:
- Airline A: 10 million x 0.3% = 30,000
- Airline B: 8 million x 1% = 80,000

We then add these and use the proportion allocated to each airline to calculate the amount of levy they pay:
- Total = 30,000 + 80,000 = 110,000
- Cost for airline A = £10 million x 30,000 / 110,000 = £2.73 million. This is equivalent to 27p per passenger
- Cost for airline B = £10 million x 80,000 / 110,000 = £7.27 million. This is equivalent to 91p per passenger

5.24 If there is insurance held, either through an arrangement with government or purchased commercially, we have used the same methodology. This assumes the government aims to charge a commercial rate to take on the risk. An example of how the insurance charge would be calculated and then allocated is:

> If we assume that for the previous example, the fund pays for reinsurance which covers the risk above the fund size. This would therefore be any years where claims exceeded £10m.

> The charge calculated would be made up of three parts:

  - The expected value (mean average) of that claim – e.g. £0.5m
  - A charge for the capital, made up of a return on capital assumption multiplied by the capital assumed to be required by the insurer. We assume the insurer would hold capital to cover a 1 in 200 year risk[7]. For example, if the capital requirement were £15m, and the return on capital were 8%, we would estimate this charge at 8% x £15m = £1.2m
  - An expense loading of (say) 10% of the total insurance premium, i.e. £0.2m.

[7] It is a Solvency II requirement to hold capital to cover a 1 in 200 year risk over one year

- The total insurance premium in this example would therefore be £0.5m + £1.2m + £0.2m = £1.9m.
- Allocating this over the 100m passengers would give a per passenger cost of 2p.
- Therefore the total passenger charge would be 3p + 2p = 5p in this example.
- This approach gives an indicative cost for an insurance premium. It ignores a number of factors including:
    - Capital held for other risks, for example operational risks and market risk
    - Reduction in capital allowed for diversification due to an insurer holding this risk alongside the rest of their portfolio
    - Insurers in general hold more than the minimum level of capital for extra protection.

6 Results – Overall distribution and sensitivity

6.1 This section of the report sets out the estimates of the cost of providing repatriation cover in the case of airline insolvency, and estimates of how those costs are allocated according to the different policy options being considered.

Estimating the cost of providing repatriation in the case of airline insolvency

6.2 Using the methodology set out in Section 5 of this report we have calculated the expected annual cost (mean average) of providing repatriation in the case of airline insolvency as £6.8m. This figure has been estimated by calculating the average cost of the 100,000 Monte Carlo simulations (see Appendix B: for further details). The cost is based on data for 2018 from ICF.

Table 6.1 – Expected annual cost of providing repatriation cover in the case of airline insolvency with different levels of other cover assumed

Approach	Expected annual cost (mean average) (2018)
1. No other passenger cover	£6.8m
2. Cover excluding ATOL	£4.5m

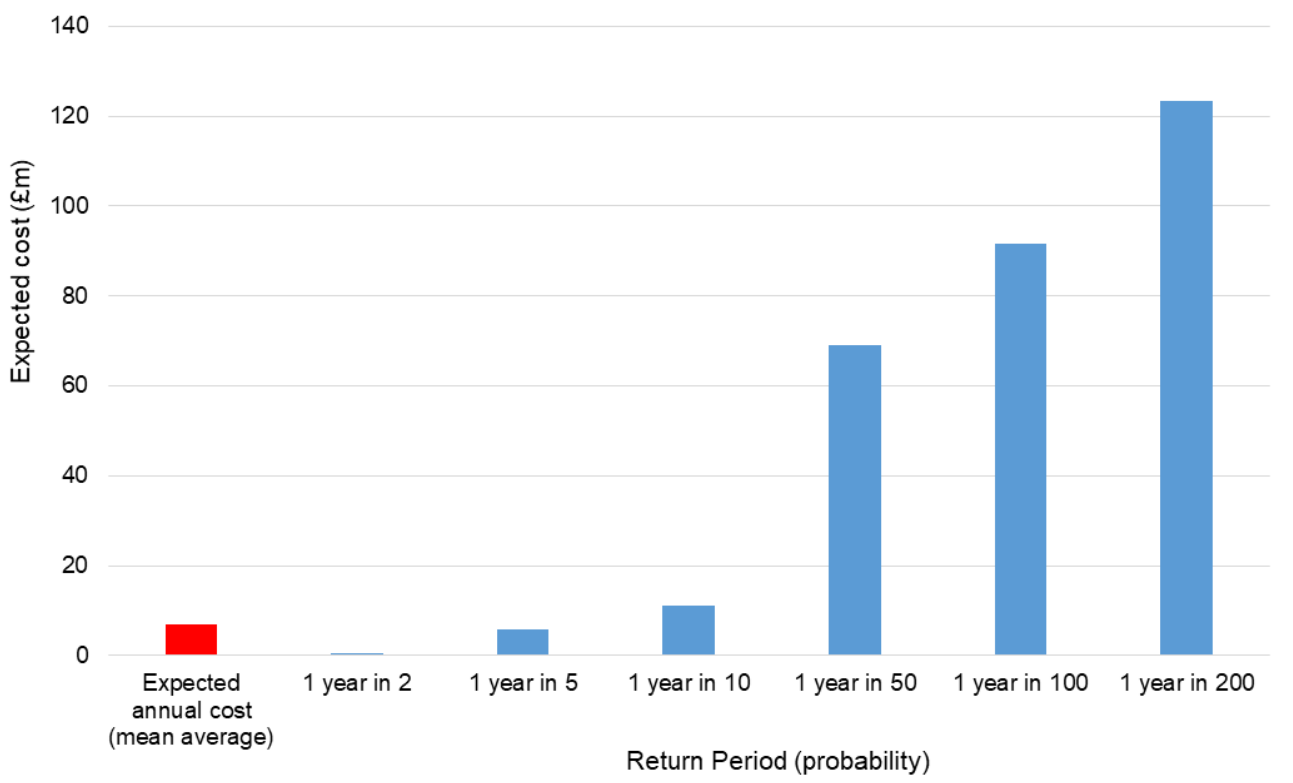
6.3 The expected cost includes costs of repatriating all passengers before any allowance is made for that part of the cost covered by other means (No other passenger cover). It also shows the costs excluding those which would be covered by the ATOL scheme (Cover excluding ATOL). To look at this further we will look in more detail at case 1.

Estimated distribution of the annual cost (assuming no other passenger cover)

6.4 Due to the inherent uncertainty as to whether or not each airline becomes insolvent we have also estimated a distribution of the cost of repatriation. The calculated distribution gives the potential range of the annual cost of repatriation based on different airlines and number of airlines becoming insolvent. To show this distribution we can consider the estimated cost at different return periods (probabilities)[8]:

[8] A return period is an estimate of the likelihood of an event. For example a 1 in 10 year return period shows the estimated cost that would be expected to happen once in every 10 years. For the calculations carried out the 1 in 10 event would be the 90,000th worst result from the 100,000 simulations.

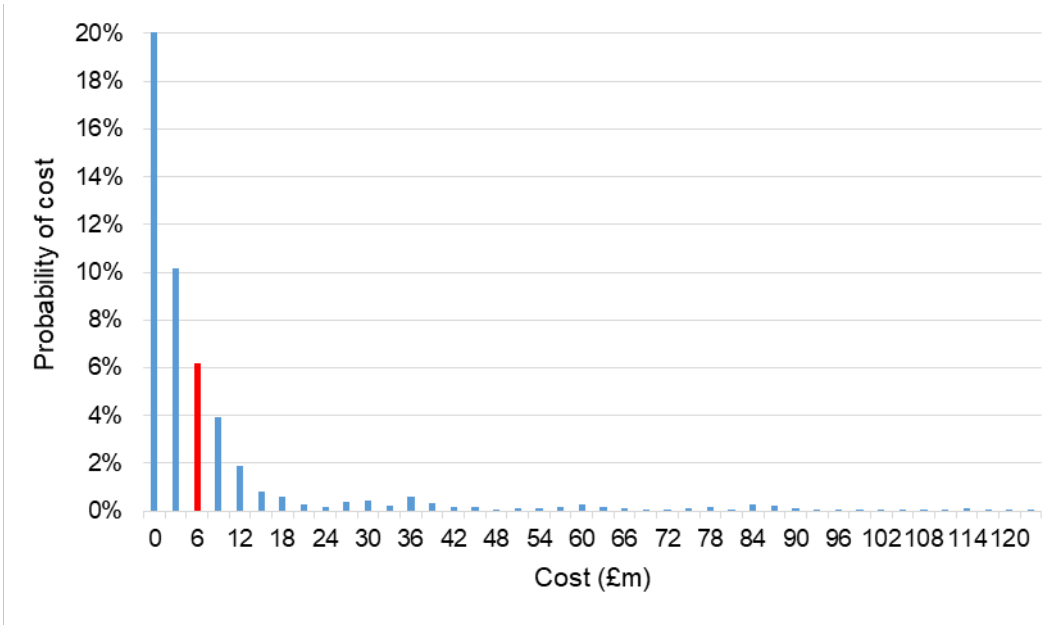
Chart 6.1 – Expected cost of providing repatriation cover in the case of airline insolvency at different return periods



6.5 As can be seen from Chart 6.1 the cost of providing repatriation increases as the likelihood of such an annual cost occurring decreases. At a 1 in 10 year return period and above the expected annual cost of providing repatriation is greater than the expected annual cost. By considering return periods in this way we can see the potential range of the cost of repatriation to different severities of airline insolvency. The expected cost (mean average) of £6.8m is close to the 1 in 5 year return period cost. We would therefore expect this cost to be exceeded broadly once every five years.

6.6 In addition to considering the annual cost of repatriation in terms of return periods we can consider the full distribution of the estimated annual cost as shown in Chart 6.2 below.

Chart 6.2 – The distribution of the estimated annual cost of repatriation cover in the case of airline insolvency



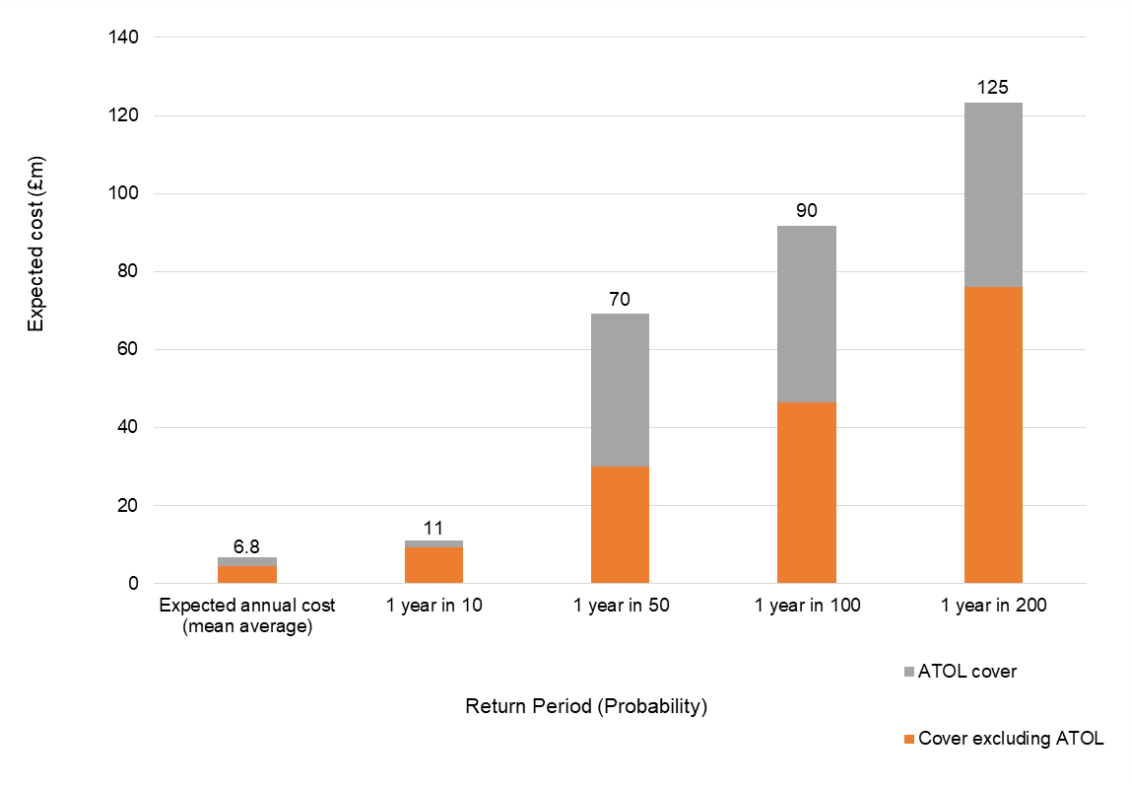
6.7 The above chart shows the expected annual (mean average) cost of £6.8m in red to clearly show where the average value falls in the calculated distribution. The above chart has also been curtailed close to the associated cost of the 1 in 200 return period (£125m) (x-axis) to demonstrate the long tail of the distribution. It has also been curtailed at a 20% likelihood (y-axis) to make the associated costs visible on the chart. If the chart had not been curtailed the largest simulation of the cost of repatriation is c£700m, although based on this analysis the likelihood of such a loss size is negligible. The likelihood of an estimated annual cost between £0m - £3m is c70%.

6.8 It can be seen in Chart 6.2 that the distribution fluctuates such that (for example) a claim of £84m is more likely than a claim of £24m. This is due to the "lumpiness" of the risk where the larger airlines tend to have a low probability of insolvency with a high cost. A result at one particular cost (e.g.£36m) could be due to a number of simulations where one larger airline with a repatriation cost close to £36m goes insolvent, or a simulation where several smaller airlines with combined costs of £36m go insolvent.

Estimated distribution of the annual cost with different levels of other passenger repatriation cover

6.9 The distributions above include costs of repatriating all passengers before any allowance is made for that part of the cost covered by other means such as ATOL, SAFI or credit card protection. We have also looked at the cost distribution excluding those which would be covered by the ATOL scheme. This illustrates the cost if cover is in place for repatriation where the data shows that this applies.

Chart 6.3 – Expected cost of providing repatriation in the case of airline insolvency at different return periods – varying levels of cover:



6.10 Chart 6.3 shows the cost at different return periods and levels of cover. It is clear that ATOL provides a significant level of repatriation costs under the assumptions used for these calculations (see Appendix C), especially at the lower probabilities.

6.11 Table 6.2 summarises the annual cost distribution for different levels of cover at selected return periods, in addition to including the maximum simulation value.

Table 6.2 - Summary of annual cost distribution

Approach	Expected annual cost (mean average) (2018)	1 in 50	1 in 200	Maximum (1 in 100,000)[9]
1. No other passenger cover	£6.8m	c£70m	c£125m	c£700m
2. Cover excluding ATOL	£4.5m	£30m	c£75m	c£440m

[9] This result is an example of the most expensive out of 100,000 simulations. Due to the nature of Monte Carlo simulations it is not a fixed number and will be different if the simulations are generated again. It is also volatile as at this level of probability the larger airlines with low chance and high cost of insolvency will sometimes be included and sometimes not.

Sensitivity Results

6.12 The results shown above are very sensitive to the assumptions adopted. When considering the results presented in this report, the potential effects on the results of using differing assumptions should also be considered.

6.13 In particular we consider the results to be particularly sensitive to three key assumptions:

> **Insolvency probabilities** – We have carried out three different comparisons of using different insolvency probabilities to illustrate the possible different outcomes.

> **Cost of Keeping the Fleet Flying** – When airlines enter insolvency they are likely to be holding debt and it may be necessary to clear this debt, at least in part, for the successful operation of a keep the fleet flying operation. The ICF data allowed for debt amounting to 2 weeks of operating costs of airlines to be paid by repatriation cover in cost estimates where the airlines are kept flying (applicable only to British Airways, Easyjet and TUI). We have estimated the impact if this allows for 4 weeks to reflect the uncertainty and impact of this assumption.

> **Correlation between airline insolvency** – It is reasonable to assume that there may be correlation between airline insolvencies. This could be due to:

- The impact of one airline insolvency on other airlines – This could increase business for other airlines, potentially reducing their insolvency probabilities, leading to a negative correlation – i.e. one airline becoming insolvent would reduce the likelihood of others becoming insolvent.
- The impact of factors affecting more than one airline, for example rising fuel prices. This would lead to a positive correlation – i.e. all airlines would be more likely to become insolvent.

We have therefore illustrated the possible impact of this correlation as follows:

- We have calculated the cost under the no cover scenario where the correlation between the probabilities of insolvency for each airline set as 25%. We have also tested the effect when it is set as -25%.
- This examines the effect of positive and negative correlation between airlines.

Table 6.3 - Summary of correlation impact on repatriation cover cost

Approach	Expected annual cost (2018)	1 in 50	1 in 200
Correlation = 0 (i.e. no correlation)	£6.8m	c£70m	c£125m
Correlation = 25%	£6.8m	c£80m	c£160m
Correlation = -25%	£6.8m	c£70m	c£125m

Insolvency probabilities

Historic insolvency probabilities

6.14 We have investigated how insolvency probabilities compare against historic airline insolvency data, how they would change if we used a different credit rating agency, and how they might change in a "stressed" year.

6.15 ICF have assessed that the annual average number of passengers requiring repatriation due to airline insolvency over the period 2008 to 2018 is 19,500. In our report dated June 2018 we estimated this as 36,000 passengers per year, using a similar methodology as we have used in this report. We now estimate this number to be c14,000 passengers per year. The difference between these estimates is as a result of two main factors:

> A definition of affected passengers covering a smaller population: Our June report covered all passengers flying out of UK airports. This report covers repatriation of a smaller number of passengers.

> A general reduction in the estimated insolvency probabilities of airlines where credit ratings are not available. For example, in our June report we estimated a 24% chance that one or more airlines (of the group of large airlines covered in that report) would become insolvent in one year. Based on the updated insolvency probabilities we now estimate that number to be 13%.

Different agency insolvency probabilities

6.16 If ICF had used an alternative credit rating for airlines this would give different results due to differences in ratings agency methodologies and transition rates (the historic rates which lead to insolvency probabilities). To illustrate this we have looked at a group of airlines where a public credit rating is available from Standard and Poors (S&P) instead of Moody's. Table 6.4 shows the comparison. This selection has been made based on the larger airlines serving the UK where both Moody's and S&P ratings are available.

Table 6.4 – Ratings agency differences

Airline	Moody's credit rating	Insolvency probability from data	S&P credit rating	S&P insolvency probability	Difference
EasyJet	Baa1	0.13%	BBB+	0.11%	-0.02%
British Airways	Baa3	0.25%	BBB-	0.25%	0.00%
American	Ba1	0.44%	BB-	1.00%	+0.56%
TUI AG	Ba2	0.71%	BB	0.56%	-0.15%
United	Ba3	1.36%	BB	0.56%	-0.80%
Thomas Cook	B1	1.97%	B+	2.08%	+0.11%

6.17 It can be seen from Table 6.4 that some of the insolvency probabilities are very similar, with some lower and some higher when using S&P when compared to Moody's. This illustrates the uncertainty in these probabilities when estimating the cost of providing repatriation cover. To illustrate the possible change to the results of this difference, an overall increase in insolvency probabilities of 0.5% over all airlines would increase the expected average claim for all airlines (assuming no passenger cover) by c£6m, nearly doubling it.

Stressed insolvency probabilities

6.18 Finally, to further illustrate the uncertainty of the insolvency probabilities we have carried out the cost calculations with the insolvency probabilities adjusted to illustrate what they could be during a stressed period. To do this we have downgraded all credit ratings by 1 major increment. For example an airline with a credit rating of Baa1 has been downgraded to Ba1. For this particular airline the insolvency probability has been increased from 0.13% to 0.44% to allow for this. The impact on the cost of cover is shown in Table 6.5.

Table 6.5 - Summary of annual cost distribution – Stressed insolvency probability

Approach	Insolvency probabilities	Expected annual cost (2018)	1 in 50	1 in 200	Maximum
1. No passenger cover	Unstressed	£6.8m	£70m	£125m	c£700m
	Stressed	£27m	£205m	£490m	c£850m
2. Cover excluding ATOL	Unstressed	£4.5m	£30m	£75m	c£440m
	Stressed	£19m	£125m	£410m	c£590m

6.19 This shows significant increases in the expected costs. In particular the tail risk represented by the 1 in 200 cost, which would likely have a big impact on insurance cost, has also risen sharply.

Keep the fleet flying costs

6.20 The impact of increasing the "Keep the fleet flying" costs to allow for debt clearance equivalent of four weeks of operating cost rather than two weeks is shown in Table 6.6:

Table 6.6 - Summary of annual cost distribution – Double keep the fleet flying cost

Approach	KFF costs	Expected annual cost (2018)	1 in 50	1 in 200	Maximum
1. No passenger cover	2 weeks	£6.8m	£70m	£125m	c£700m
	4 weeks	£8.6m	£70m	£185m	c£1070m

6.21 Table 6.6 shows a relatively small impact on the costs of increasing the keep the fleet flying costs. This is because this only affects three airlines and of these, the impact of the larger two falls with very low probability i.e. less than 1 in 200. However this uncertainty may have other impacts, for example on increasing the cost of insurance.

7 Results – Cost of policy options

7.1 The previous section described the results of the simulations of the cost of repatriations in the form of a distribution of costs. As outlined in Section 4 on Policy Options the costs associated with funding these can be met from different sources, for example some costs will be passed to insurers in exchange for a premium where risk is placed with insurers.

7.2 We have used the simulated repatriation cost distribution above to provide estimates of the costs that would be expected to be payable under each of the policy options in respect of:

- Premiums payable to any risks ceded to insurers
- Levies payable to any central fund that pools risks
- Costs incurred by airlines in providing security.

7.3 **This has been done assuming that no existing cover (ATOL, SAFI, Credit card protection) applies.** We have made no allowance in these costs for administrative costs and expenses of a fund or organising body to administer the repatriation protection. There is also no allowance made for other costs, such as expenses of third parties which may be necessary to implement some of the repatriations. In the case of organised charter and keeping the fleet flying it may be necessary to provide an indemnity for the insolvency practitioner.

7.4 We have also made assumptions about the levels at which different forms of cover (levy, security, insurance, etc.) are set in order to illustrate possible costs. If implemented further market testing would be required in order to set these levels and secure market participation.

Estimating insurance premiums

7.5 It should be noted that the estimates of insurance premiums are indicative and based on a number of assumptions which can be seen in Appendix C. They are estimated in the same way for insurance provided by government and by insurance companies. This reflects an assumption that the government would charge on a commercial basis for any insurance provided. To estimate the insurance premiums they assume:

- The premium charges for expected claims, a capital charge and expenses
- There is no allowance for other risks against which an insurer may need to hold capital, for example operational risks and market risk. There is also no allowance for any reduction in capital held as a result of the benefits of diversification to an insurer of holding this risk alongside the rest of their portfolio. There is also no allowance for insurers in general holding more than the minimum level of capital for extra protection.

Estimating levies and fund sizes

7.6 Where a fund is needed and there are options for how that fund is managed. In managing the fund, choices need to be made on:

- Who pays for the initial fund build up – e.g. airlines through a higher initial levy until the fund is built up to the desired level.

> If the fund is built up over time, how payouts are managed during that time – for example using insurance temporarily to “top up” the fund until it is built up.

> How to manage the fund level as this will naturally fluctuate over time. This could be managed through adjusting levy amounts to collect more if the fund is lower than the desired level, and less when it is higher.

7.7 In calculating levies we have assumed that the fund remains at a steady state at the desired level and levies cover the expected claims on the fund each year.

Estimating cost of providing security

7.8 Where security is required from an airline as part of an option we have estimated this as being the same as the cost of insurance. This is only an indicative estimate as the actual cost of security will depend on a number of factors which we have not allowed for, including:

> The indirect cost to the airline of granting charges over its assets (e.g. higher cost of borrowing)

> The terms and nature of the security

> The credit risk of the security provider

> Any additional cost of protection should it be decided to cover the credit risk of the security provider

Shortlisted Options

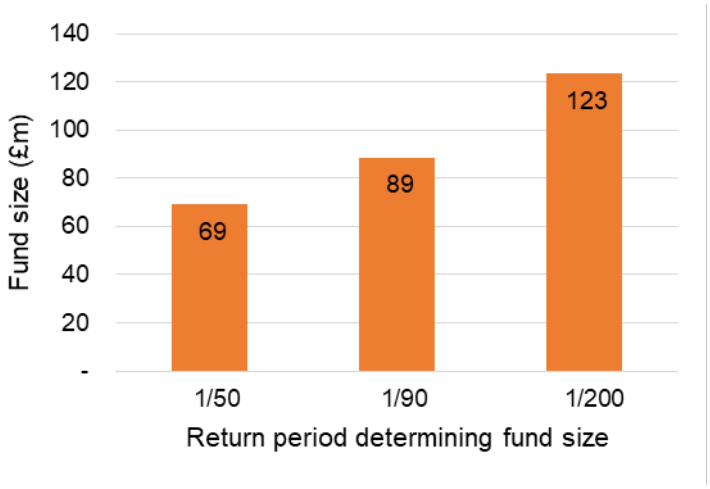
Option C1 – Flat Levy

C1	Flat Levy	All airlines levied a flat surcharge per passenger. Levies paid to a fund assigned to a coordinating authority to pay out on airline insolvency.	Funded Partially risk-based (through passenger numbers) Claims in excess of fund need to be taken by insurer or government

7.9 First loss is paid by the levy fund. Any loss beyond this is paid by an insurance arrangement which could be with an insurer, a panel of insurers, government, or a combination of these.

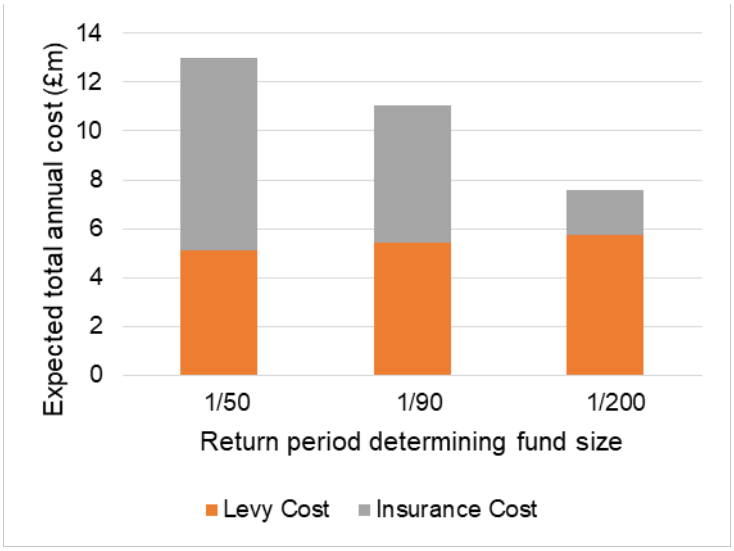
7.10 We have assumed the target size of the levy fund is set at a level determined by a return period event which the fund is designed to cover, for example the fund is large enough to pay out for a 1 in 90 year event. The estimated levy fund values are shown in Chart 7.1. This shows that if the levy fund were designed to meet costs up to a return period of 1 in 50, a fund of £69.2m would be appropriate based on the estimated risk profile, and data and assumptions used.

Chart 7.1 – Expected levy fund size at different return periods – varying levels of cover



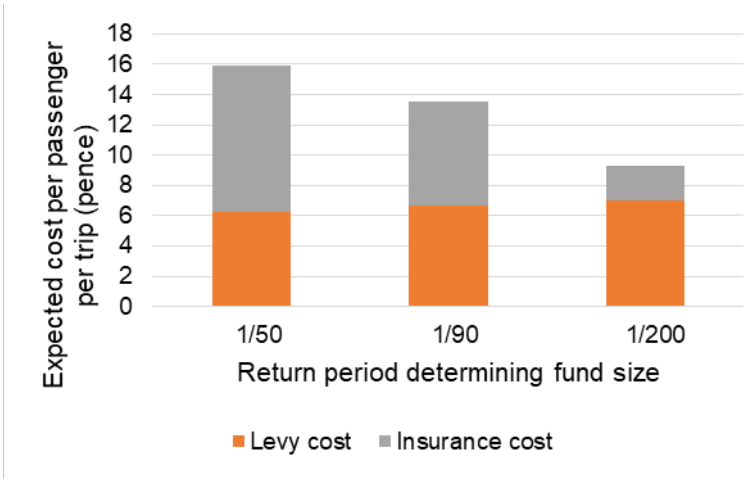
7.11 We have then estimated the total cost of cover and then what that cost might be per protected passenger. These are shown in Charts 7.2 and 7.3 below. The Insurance Cost shown is the cost of insurance to cover any costs of repatriation in excess of the levy fund size.

Chart 7.2 – Expected total annual cost of providing repatriation cover in the case of airline insolvency for option C1



7.12 Chart 7.3 shows the cost of cover expressed per passenger, broken down by levy cost and insurance cost.

Chart 7.3 – Expected annual cost per passenger of providing repatriation cover in the case of airline insolvency at different return periods



7.13 Charts 7.2 and 7.3 show the total cost of the levy and insurance becoming cheaper as more of the risk is taken by the fund. This is a combination of:

> Insurance cost reducing as the fund size gets bigger (return period / probability gets lower) so the insurance has to cover a lower amount of cost as the fund covers more.

> Levies rising as the fund size increases, to meet expected claims on the fund.

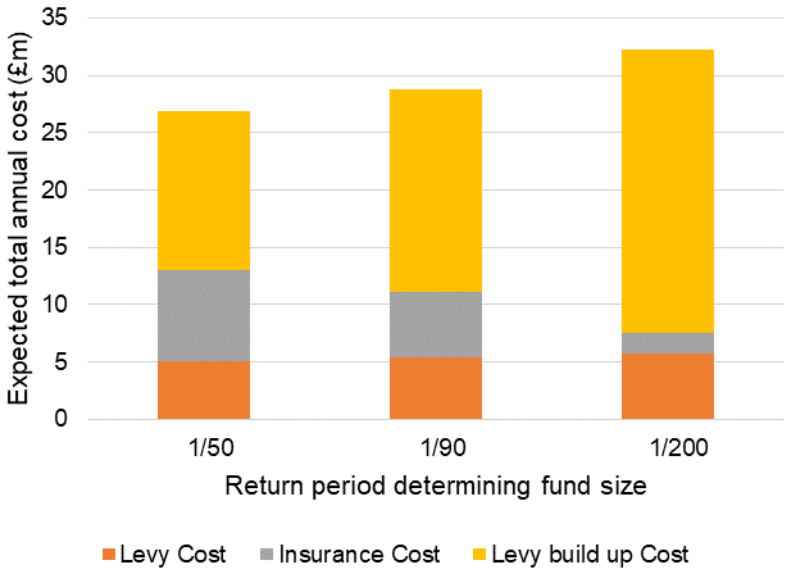
7.14 The levy cost does not rise at the same rate as the insurance cost falls, largely because the levy fund does not charge for capital held. There are a number of additional factors that will affect the overall cost:

> There is an opportunity cost of holding a larger fund which is not taken into account. This is the cost of holding that money in reserve when it could be used to generate a return elsewhere.

> Building up the fund will incur an initial cost. For example the fund is between c14 times (1/50) and c22 times (1/200) the annual levy. Chart 7.4 illustrates the cost of building up the levy.

> Chart 7.4 shows the total annual cost for each of the three cases shown above if the fund is built up from nothing over a five year period. After this five year period the cost would be expected to return to the levels shown in Chart 7.3 (ignoring the effects of passenger growth / inflation etc.).

Chart 7.4 – Expected annual cost of providing repatriation cover and fund build up over five years



7.15 In this example of building the levy up over a five year period from nothing we would therefore expect that:

> Where the levy fund is built up to cover the 1 in 50 year risk, the annual cost would be £27m per year for the first 5 years and £13.0m per year after that

> Where the levy fund is built up to cover the 1 in 90 year risk, the annual cost would be £29m per year for the first 5 years and £11.1m per year after that

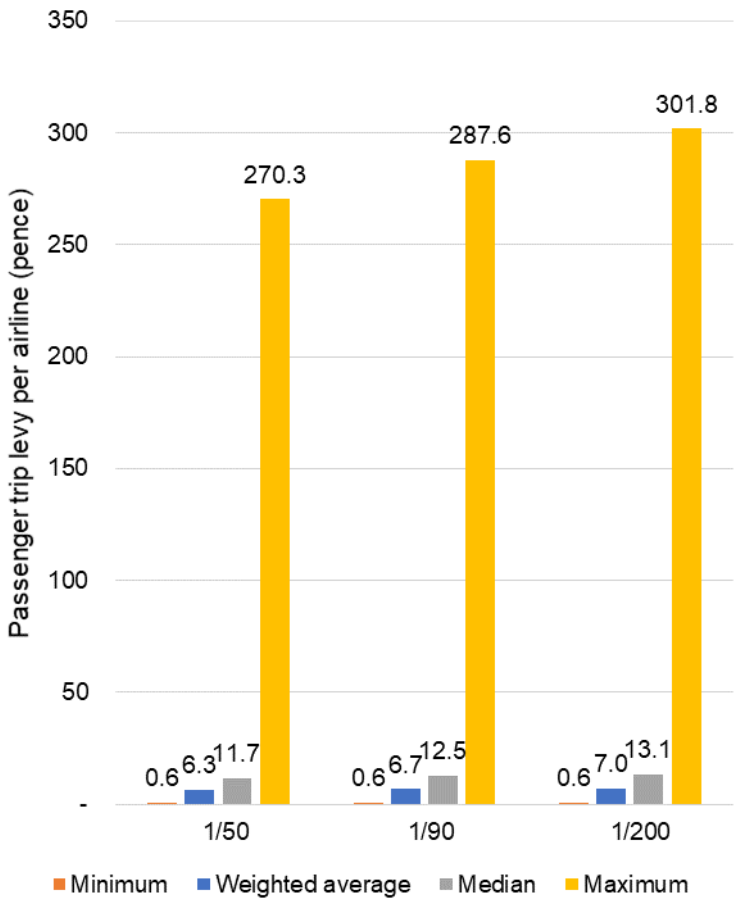
> Where the levy fund is built up to cover the 1 in 200 year risk, the annual cost would be £32m per year for the first 5 years and £7.6m per year after that

Option C2 –Risk-Based Levy

C2	Risk-Based Levy	As C1 with levy risk-based, based on passenger numbers and insolvency risk of airline.	Funded Fully risk-based Claims in excess of fund need to be taken by insurer or government

7.16 This differs from option C1 in that the amount of levy charge varies by airline. The total levy which needs to be collected is unchanged but the amount collected from each airline is different. To illustrate this we have weighted the levy by airline in line with the insolvency risk of each airline. We have used the same airline insolvency risk as used in the calculations to determine the profile of risk. The range of levies charged to each airline is shown in Chart 7.5

Chart 7.5 – Risk-based levy: Range of annual cost per passenger of risk based levy



7.17 This method of setting the levy maps it to the weighted insolvency risk and leads to the "riskiest" airlines paying nearly 500 times more than the least "risky" airlines. Alternative mechanisms could be used to set the risk-based levy which would reduce this difference but would result in more cross-subsidy (as there is already cross-subsidy in the insurance cost as that is charged uniformly across all airlines per passenger with no allowance for the risk).

Option C3 –Variable Levy

C3	Variable Levy	As C1 with two options for airlines: 1. Pay a levy as per C1 2. Provide security fitting a set of criteria which would provide repatriation cover on airline insolvency	Partially funded Partially risk-based (through passenger numbers and security pricing) Risk partially pooled Claims in excess of fund taken by insurer or government Choice for airlines

7.18 The cost of this option is difficult to estimate due to the element of choice for airlines. If the levy is flat per passenger (as in option C1) it is reasonable to expect that:

> Airlines with lower insolvency probability are more likely to buy security as it will be cheaper for them than paying the levy, and

> Airlines with higher insolvency probability are less likely to buy security as it will be more expensive for them than paying the levy, or may not be available at all.

7.19 If all airlines choose to pay the levy we estimate the cost to be the same as option C1 above (Flat Levy). If all airlines choose to give security we estimate the cost to be the same as insuring each airline. This is summarised in Table 7.1 below:

Table 7.1– Summary of estimated annual 2018 costs of option C3 – Variable levy

	Total annual cost (£m)		
Fund size return period	1/50	1/90	1/200
All airlines pay levy	13.0	11.1	7.6
All airlines provide security	43.6	43.6	43.6

7.20 The main reason that the second option (providing security) is much more expensive is that it doesn't pool the risks – each airline is individually providing security. The cost where all airlines provide security is calculated as described for Option E below.

Option E –Airline Security Package

E	Airline Security Package	Airlines mandated to provide security fitting a set of criteria which would provide repatriation cover on airline insolvency	Unfunded Risk-based Risk not pooled (as all airlines seeking individual security)

7.21 We have assumed that the cost of security to airlines is the same as our estimate of the cost of insurance as described in the introduction to this section.

7.22 We have then estimated the total cost of cover and the cost per passenger per flight. This comes to £43.6m per year, or 54 pence per passenger per flight. This is the most expensive cost option due to the assumption that none of the airline risks are pooled.

7.23 We have also estimated the total cost of cover if all the risk were to be pooled with one provider, for example a central insurer which can pool the risk through reinsuring with a panel of insurers. If one provider (or a group of providers) were able to pool all risks this estimate reduces to £21.2m per year, approximately half of the indicative cost of providing individual security or insurance to each airline.

Structuring Options

Option S1 –Security and Government Reinsurance

S1	Security and Government Reinsurance	Airlines mandated to provide security up to a limit, fitting a set of criteria which would provide repatriation cover on airline insolvency. Claims in excess of this limit covered by reinsurance provided by government.	Unfunded Risk-based Risk not pooled (as all airlines seeking individual security) Claims in excess of security taken by government

7.24 To provide an estimate the cost of this option we have treated it as being the same as Shortlisted Option E. We have therefore estimated the total cost of cover at £43.6m per year and the cost per passenger per flight at 54 pence per passenger per flight.

7.25 Capping the security at a limit and providing government reinsurance to cover claims in excess of this limit will reduce the cost from £43.6m due to the pooled nature of the reinsurance. If one provider (or a group of providers) were able to pool all risks as described in Option E above this estimate reduces to £21.2m per year.

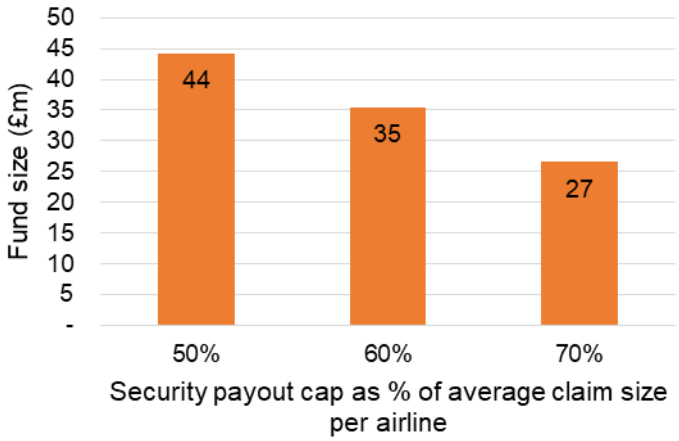
Option S2 –Security, Levy Fund, and Government Reinsurance

S2	Security, Levy Fund, and Government Reinsurance	Airlines mandated to provide security up to an airline-specific limit, fitting a set of criteria which would provide repatriation cover on airline insolvency. Claims in excess of this limit covered by a levy fund up to a second overall limit. Claims in excess of the overall limit covered by reinsurance provided by government.	Partially funded Partially risk-based (through passenger numbers and security pricing) Risk partially pooled Claims in excess of fund taken by government

7.26 The level to which security pays out for each airline needs to be fixed (annually). We have assumed that the fixed amount is set as a percentage of the average monthly repatriation cost exposure for each airline and this is the level above which the levy fund pays out.

7.27 The levy fund levels, and annual costs can be seen in Charts 7.6 – 7.8. It should be noted that these costs are indicative and approximate. We have assumed that the levy covers the risk up to a return period of 1 in 90.

Chart 7.6 – Expected levy fund size at different caps on security payout

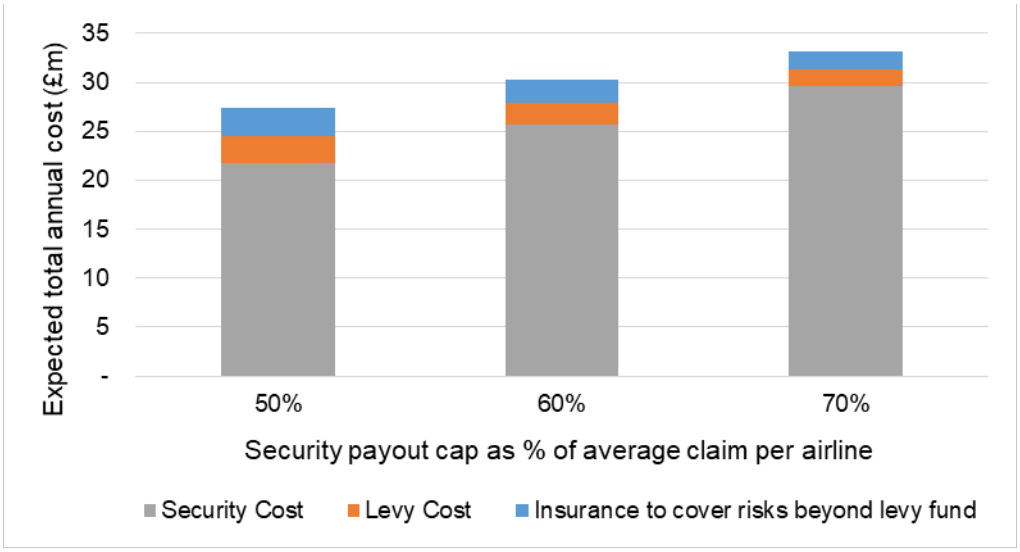


7.28 Chart 7.6 shows the estimated size of levy fund needed to cover the claims in excess of the individual airlines' security arrangements, up to a return period of 1 in 90. We set out an example below where the security is designed to cover 60% of the average claim size (repatriation cost) for an airline:

> Airline A has a repatriation cost on insolvency which is £80m at high season, and £55m at low season, with an average of £70m. Airline A provides security to cover repatriation costs up to 60% of £70m = £42m.

> If Airline A goes insolvent at high season, the repatriation cost will be £80m. £42m of this will be met by security. The next £35m would be met by the fund, assuming it is at the desired level, and in this case exhausting the fund. This leaves a further £3m to be paid from the insurance in place to cover claims in excess of the fund.

Chart 7.7 – Indicative expected total annual cost of providing repatriation cover in the case of airline insolvency



7.29 As with all levy fund options there are issues around opportunity cost of holding a larger fund and the issues around managing a fund and charging levy, as described above under option C1.

Option S3 –Security, Levy Fund, Commercial and Government Reinsurance

S3	Security, Levy Fund, Commercial Reinsurance, and Government Reinsurance	Airlines mandated to provide security up to an airline-specific limit, fitting a set of criteria which would provide repatriation cover on airline insolvency. Claims in excess of this limit covered by a levy fund up to a second lower overall limit. Claims in excess of the second lower overall limit are covered by commercial reinsurance up to a third higher overall limit. Claims in excess of the higher overall limit covered by reinsurance provided by government.	Partially funded Partially risk-based (through passenger numbers and security pricing) Risk partially pooled Claims in excess of fund taken by commercial insurer and government

7.30 We have assumed that the cost of government reinsurance is estimated on a commercial basis and is therefore the same as the cost of commercial insurance. This means that when estimating costs for this option the cost of the commercial and government reinsurance can be estimated in the same way. The total overall cost is therefore going to be the same as option S2 where the Government Reinsurance cost for option S3 is split into two parts – of commercial and government reinsurance.

Option S4 – Levy Fund, Commercial Reinsurance, and Government Reinsurance

S4	Levy Fund, Commercial Reinsurance, and Government Reinsurance	All airlines levied a flat surcharge per passenger. Levies paid to a fund assigned to a coordinating authority to pay out on airline insolvency. Claims in excess of the fund covered by commercial reinsurance up to a limit. Claims in excess of the limit covered by reinsurance provided by government.	Funded Partially risk-based (through passenger numbers) Claims in excess of fund need to be taken by insurer and government

7.31 This option is costed in the same way as option C1 – a levy fund with Government Reinsurance.

Option S5 – Levy Fund and Government Reinsurance

S5	Levy Fund and Government Reinsurance	All airlines levied a flat surcharge per passenger. Levies paid to a fund assigned to a coordinating authority to pay out on airline insolvency. Claims in excess of the fund covered by reinsurance provided by government.	Funded Partially risk-based (through passenger numbers) Claims in excess of fund need to be taken by government

7.32 This option is the same as option C1.

Summary of costs

7.33 Tables 7.2 and 7.3 shows a summary of the estimated costs of the different options for providing repatriation cover:

Table 7.2 – Summary of estimated annual 2018 costs of the shortlisted policy options – Repatriation costs assuming no other existing cover

Option	Total annual cost (£m)			Levy fund size (£m)		
Fund size return period	1/50	1/90	1/200	1/50	1/90	1/200
C1 – Flat Levy	13.0	11.1	7.6	69	89	123
C2 – Risk Based Levy	13.0	11.1	7.6	69	89	123
C3 – Variable Levy – all levy	13.0	11.1	7.6	69	89	123
C3 – Variable Levy – all security	43.6			0		
E – Airline Security	43.6			N/A		

Table 7.3 – Summary of estimated annual 2018 costs of the Structuring options – Repatriation costs assuming no other existing cover

Option	Total annual cost (£m)			Levy fund size (£m) Assumes levy fund covers up to 1/90 risk unless otherwise stated		
S1 – Security						
Security cost	43.6			N/A		
S2 & S3 – Security, Fund & Reinsurance						
Cap on security payout as proportion of average monthly cost exposure	50%	60%	70%	50%	60%	70%
Security cost	21.9	25.8	29.8	44	35	27
Levy cost	2.7	2.2	1.6			
Reinsurance cost	2.8	2.3	1.8			
Total Cost	**27.4**	**30.3**	**33.2**			
S4 & S5 – Levy Fund & Reinsurance						
Fund size return period	1/50	1/90	1/200	1/50	1/90	1/200
Levy cost	5.1	5.5	5.7	69	89	123
Reinsurance cost	7.9	5.6	1.9			
Total Cost	**13.0**	**11.1**	**7.6**			

7.34 When comparing cost of options with and without levy funds in the tables above (for example comparing option C1 with Option E) two important factors need to be taken into account.

> No allowance has been made for the opportunity cost of holding money in reserve in a fund when it could be used to generate a return elsewhere. If this allowance were made, the fund options (C1-3, S2-5) would be more expensive.

> No allowance has been made for costs of building up the funds. An example of how this could work for option C1 is shown in Chart 7.4 above.

7.35 When comparing the costs for different fund sizes within the same option the same issues apply. This is because varying the fund size in these cases (e.g. in option C1 the fund size varies from £69m to £123m) changes the share of the cost covered by insurance and by the fund.

Table 7.4 – Summary of estimated annual 2018 costs of the Structuring options on a per passenger basis – Repatriation costs assuming no other existing cover

Option	Cost (£) per passenger								
S1 – Security	Average			Min			Max		
Total cost	**0.54**			**< 0.01**			**11.04**		
Cap on security payout as proportion of average monthly cost exposure	50%			60%			70%		
S2 & S3 – Security, Fund & Reinsurance[10]	Average	Min	Max	Average	Min	Max	Average	Min	Max
Security cost	0.27	0.01	5.53	0.32	< 0.01	6.51	0.36	0.01	7.51
Levy cost	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02
Reinsurance cost	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02
Total cost	**0.33**	**0.07**	**5.59**	**0.38**	**0.06**	**6.57**	**0.40**	**0.05**	**7.55**
Fund size return period	1/50			1/90			1/200		
S4 & S5 – Levy Fund & Reinsurance	Average			Average			Average		
Levy cost	0.06			0.07			0.07		
Reinsurance cost	0.10			0.07			0.02		
Total cost	**0.16**			**0.14**			**0.09**		

[10] Assumes levy fund covers up to 1 in 90 risk

7.36 If we were to allow for the cost of building up the levy fund for options S2 and S3 these costs would increase. For example, where the cap on security is set at 60% of the average monthly cost exposure, the cost of building up the fund would be an additional £7m per year over five years, or 9 pence per passenger. This would increase the total annual costs from c£30m to c37m per year, and from 38 pence to 47 pence per passenger on average.

7.37 Table 7.4 shows the costs of the structuring option on a per passenger basis.

7.38 In summary, there is a wide range of costs of these options due to two main factors:

- Pooling of risk. If we allow the risks of each airline to be treated individually the cost is higher. For example if we assume each airline separately buys an insurance policy to pay for repatriation of its passengers on insolvency, and every airline buys this from different insurers. In this case the total cost of insuring all airlines will be much higher than if all airlines bought from one central insurer which can pool the risk through reinsuring with a panel of insurers. We estimate that this difference is c50%.
- Use of a levy fund. The lowest cost options charge levies to airlines to build up a levy fund to pay for repatriation. There are three reasons why these are the lowest cost:
    - They pool risk
    - They don't allow for a cost for building up the fund in the first place, although we have illustrated this cost in Chart 7.4.
    - They don't charge for the opportunity cost of holding the fund monies. In comparison where we have estimated insurance costs we have included a charge for holding capital as that would typically be charged by insurers.

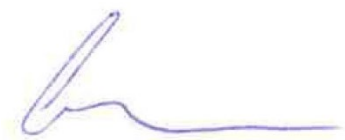
8 Limitations and professional compliance

8.1 The analysis outlined in this report has been carried out in accordance with the applicable Technical Actuarial Standard: TAS 100 issued by the Financial Reporting Council (FRC). The FRC sets technical standards for actuarial work in the UK.

8.2 This report has been prepared for the use of DfT and must not be reproduced, distributed or communicated in whole or in part to any other person without GAD's prior written permission.

8.3 Other than DfT, no person or third party is entitled to place any reliance on the contents of this report, except to any extent explicitly stated herein, and GAD has no liability to any person or third party for any act or omission, taken either in whole or part on the basis of this report.

8.4 This report must be considered in its entirety, as individual sections, if considered in isolation, may be misleading, and conclusions reached by review of some sections on their own may be incorrect.



Chris Paterson

Fellow of the Institute of Actuaries

Jack Carroll

Fellow of the Institute of Actuaries

Appendix A: Data used

A.1 Data has been provided by ICF. This data is described in their report: ICF, Airline Insolvency Review: Aviation Data & Economics. ICF are a consulting firm who have been contracted by the Airline Insolvency Review to provide the necessary data on airlines and their passengers and to provide this to GAD.

A.2 We have used their data as set out in Section 3 of this report.

A.3 We have carried out the following checks on the data:

> Consistency with the data used in our report dated 28 June 2018

> Reasonableness checks (e.g. checking long haul flights are more expensive than short haul, ATOL coverage higher for package holiday providers)

> Checks on totals and individual data

8.5 Based on these checks we consider this data to be in line with our expectations. However we have not checked the full accuracy of the data.

8.6 We have made the following adjustments to the data:

> We have adjusted the insolvency probabilities provided. The probabilities provided are based on Moody's transition rates from the assigned credit rating to default. We have adjusted these to take out the allowance for companies with withdrawn ratings. This is consistent with our approach in our report: GAD, Airline Insolvency Review – Risk Analysis Phase 1.

Appendix B: Monte Carlo Simulations

B.1 Monte Carlo simulations are commonly used to allow for, illustrate, and understand uncertainty in a calculation, particularly where you are trying to project future uncertain events. In the context of this paper we are estimating the impact of future uncertain airline insolvencies. There is limited data available on airline insolvencies as these events occur relatively infrequently.

B.2 The starting point for Monte Carlo simulations is a set of calculations. This could include a calculation of an expected cost of repatriation under airline insolvency using a fixed set of assumptions such as a chance of insolvency, a number of affected passengers etc. To introduce uncertainty into this we identify which factors are uncertain. This could be the insolvency itself, as well as the month in which it happens. For each uncertain factor we replace the fixed number with an “uncertain variable” which can take on a range of possible values.

B.3 The next step is to run a series of Monte Carlo simulations where randomly chosen values are used for each uncertain variable – e.g. whether or not the airline becomes insolvent. In order to give a meaningful representation of the spread of possible outcomes a large number of simulations are run – usually 1,000 or more and often tens or hundreds of thousands.

B.4 The values are generated such that the overall proportion of simulations where the airline becomes insolvent is expected to be the insolvency probability of the airline.

B.5 By combining each of these simulations we will produce an overall distribution of the possible costs. A simplified example of this is given in Chart 5.1.

Appendix C: Assumptions

Data accuracy

C.1 We have assumed the accuracy of the data provided ICF where we haven't checked it.

Correlations

C.2 There may be correlations between the insolvencies of the individual airlines. A positive correlation between airlines means that when one becomes insolvent it is more likely that the others will also become insolvent.

C.3 There are two conflicting aspects to consider in respect of this. It is certainly the case that the state of the economy or the costs of jet fuel are likely to affect several members at once suggesting a positive correlation.

C.4 There is a counter argument that when one airline becomes insolvent there are opportunities for the remaining airlines to pick up this business and improve their own situation. This is especially relevant for the larger airlines and could result in a negative correlation.

C.5 There is a lack of data on which to confirm the extent of this and whether it is positive or negative overall. We have concluded that using 25% (common within Solvency II modelling) is sufficient to provide illustrative calculations showing the sensitivity of the results to positive and negative correlations.

C.6 The approach used for allowing for the correlation is to use the correlation calculation built into the @Risk add-in to Microsoft Excel. This means that the correlation is applied when selecting the individual underlying random variable between 0 and 1. These correlated random variables are then used to make the decision as to whether the company has become insolvent.

C.7 There is a known complication of using correlations when using a Monte Carlo approach to model discrete (yes or no) type decisions. This can be explained through a simple example. If members A and B are correlated with a variable of 1 this means that when one becomes insolvent so does the other. In our scenario we assume that there is a correlation of 100% then the two selected random variables should be equal (say 0.2). If company A has a default probability of 0.19 but company B 0.21 then only A would become insolvent in this scenario apparently breaking the correlation 100% rule. This is an extreme example to illustrate the point, however, even with our assumed correlation sensitivity of 25% the use of @Risk correlations will reduce the apparent impact to some extent.

C.8 Coming up with a perfect solution to the correlation issue is outside of the scope of this work. This is an area where we would suggest further detailed analysis may be carried out when updating the results.

Calculating indicative insurance premiums

C.9 In calculating indicative insurance premiums we have made some broad assumptions as follows:

> The UK government will charge for risk at the same rate as a commercial insurer

- An insurer's premium is made up of the following:
  - The expected payout – i.e. the average annual expected claim
  - A capital charge, made up of the insurer's return on capital multiplied by the amount of capital held in relation to the risk. The amount of capital held is enough to cover a 1 in 200 year risk event
  - An expense loading
- In order to calculate the capital charge we need an assumed rate charged by insurers for the use of their capital. We have used 10% as the charge in this case. This is based on our experience of typical rates for insurance operations but is very dependent on individual circumstances and the state of the economy at the time. When deriving a total premium to be applied reinsurers will apply a loading to cover the expenses associated with writing and administering the business. For the purposes of this exercise we have used a rate of 10% of the total premium.

C.10 This gives an indicative cost. It ignores a number of factors including:

- Capital held for other risks, for example operational risks and market risk
- Reduction in capital allowed for diversification due to an insurer holding this risk alongside the rest of their portfolio
- Insurers in general hold more than the minimum level of capital for extra protection.

Appendix D: Option S3 examples

D.1 This appendix sets out examples of how the repatriation cover described by Option S3 would be used in practice to meet different repatriation costs. We use the examples of two different airlines and how the costs of repatriation are met by this option when they become insolvent in different circumstances.

Option S3 description

D.2 Option S3 is composed of 4 layers of cover to pay for repatriation of passengers on insolvency. There is a defined order in which each layer of cover is used so that only once the first layer is used up does the second layer of cover start to meet repatriation costs. The four layers of cover with example limits are shown below:

4. Government Reinsurance	**Layer 4 - Government reinsurance** – This pays for the remainder of any claim not fully met by the lower layers. This covers all remaining risk and therefore there is no upper limit, although the chance of claiming any costs from this layer in this example is 1 in 200. This layer is only likely to be required when one of the largest airlines becomes insolvent.
3. Commercial Reinsurance	**Layer 3 - Commercial reinsurance** – This pays the remainder of any claims not fully met by layers 1 (security) and 2 (levy fund), up to a maximum limit. In this example the limit for this commercial reinsurance layer is set to cover claims up to a 1 in 200 year claim across all airlines. This means the commercial reinsurance is unlikely to pay claims for individual insolvencies of smaller airlines, but could be used and potentially exhausted to pay claims from larger airline insolvencies.
2. Levy Fund	**Layer 2 - Levy fund** – For claims larger than the cover provided by Layer 1 (security) the additional cost would start to use up the levy fund, and may use it all up. For example the levy fund may be set up to cover any claim up to the size of a 1 in 90 year claim. This layer covers all commercial airlines serving the UK, so the limit will be the 1 in 90 year claim across all of these airlines.
1. Security	**Layer 1 - Security** – Option S3 requires airlines to purchase security up to a limit which is set at a different level for each airline. For example, airlines may be required to take out insurance which would fund 60% of their average expected cost of repatriation across a year. For each airline the cost of passenger repatriation on insolvency will be different depending on when the airline becomes insolvent – i.e. it will be more if an airline goes insolvent in high season. To calculate the average expected cost of repatriation across a year we use the cost at different dates across the year (e.g. once each month) and take an average. Unlike any of the other layers here, this security is individual to each airline – i.e. only the security arrangement for Airline X will pay out on a claim for Airline X.

D.3 To help explain how Option S3 would be used in practice we have used two example airlines :

- ‘Package Airlines’ is a medium-sized airline
- ‘Fly World Airlines’ is a large airline

D.4 We have set out five examples of Option S3 being used for repatriation cover in practice where either or both of these airlines become insolvent.

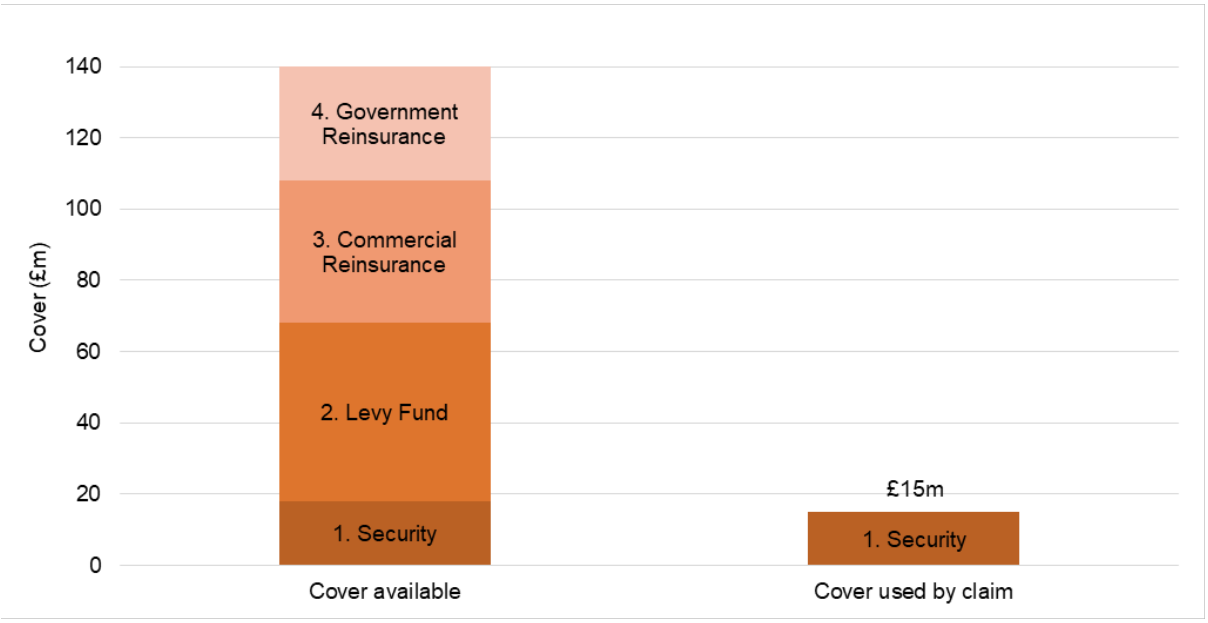
- Example 1 – Package Airlines becomes insolvent in the low season and the cost of repatriation is £15m.
- Example 2 – Package Airlines becomes insolvent in the high season and the cost of repatriation is £45m.
- Example 3 – Fly World Airlines becomes insolvent and the cost of repatriation is £200m.
- Example 4 – A combination of examples 2 and 3: In the same year Package Airlines becomes insolvent in the high season and Fly World Airlines also becomes insolvent. Therefore, the total cost of repatriation for both airlines is £245m.
- Example 5 – Two different examples of Fly World Airlines becoming insolvent – both at low season (£100m claim), and at high season (£300m claim)

D.5 For the purpose of these examples we have made the following assumptions:

- Airlines will take out security for 60% of their expected claim to cover layer 1 of any claim (the security layer). We have assumed the average expected claim for Package Airlines is £30m and for Fly World Airlines it is £200m. This means the layer 1 security for Package covers up to £18m (60% of £30m), and for Fly World it is £120m (60% of £200m).
- Layer 2, the levy fund, will cover any claims in excess of layer 1 up to the maximum size of the fund set in this example at the 1 in 90 claim for all airlines (net of the security arrangements). We have assumed the size of the levy fund is £50m.
- Commercial reinsurance will cover any claims above the levy fund up to the 1 in 200 year claim size. We have assumed the size of the commercial reinsurance layer is £40m.

Example 1 – Package Airlines becomes insolvent in the low season

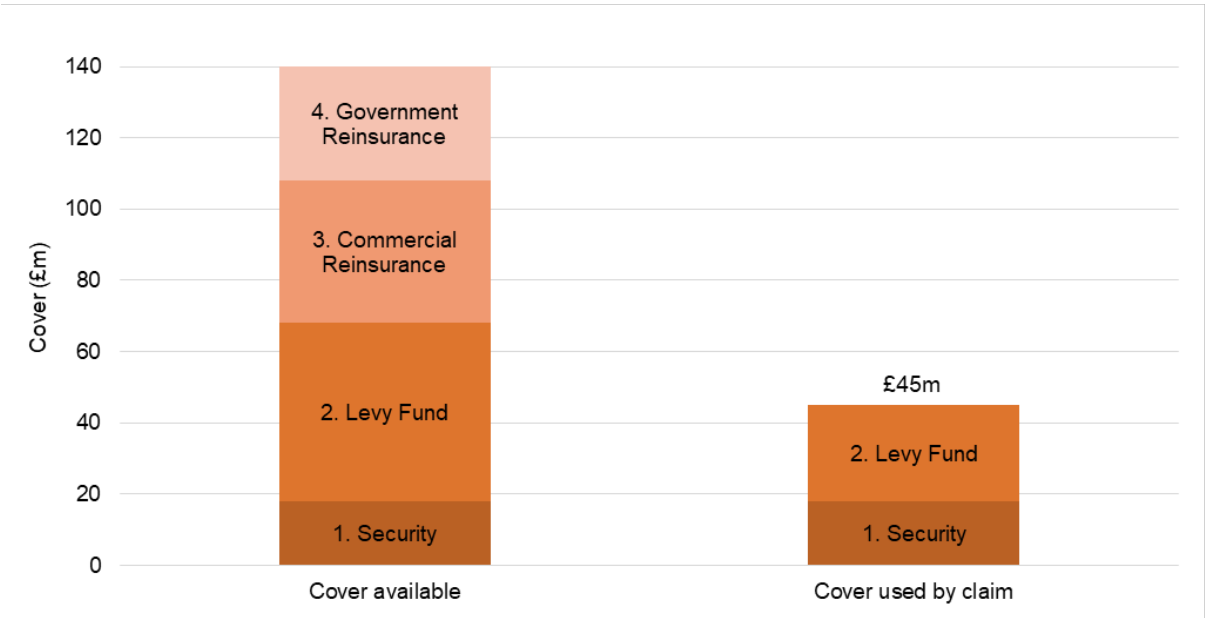
Chart D1 – The cover for Package Airlines with a cost of repatriation of £15m



D.6 In this situation only the first layer of cover is required. The cost to repatriate all of the passengers is £15m. This is less than the upper limit of the security layer of cover (£18m) so no additional cover is required to meet the full cost of repatriation and the levy fund is untouched.

Example 2 – Package Airlines becomes insolvent in the high season

Chart D2 – The cover for Package Airlines with a cost of repatriation of £45m

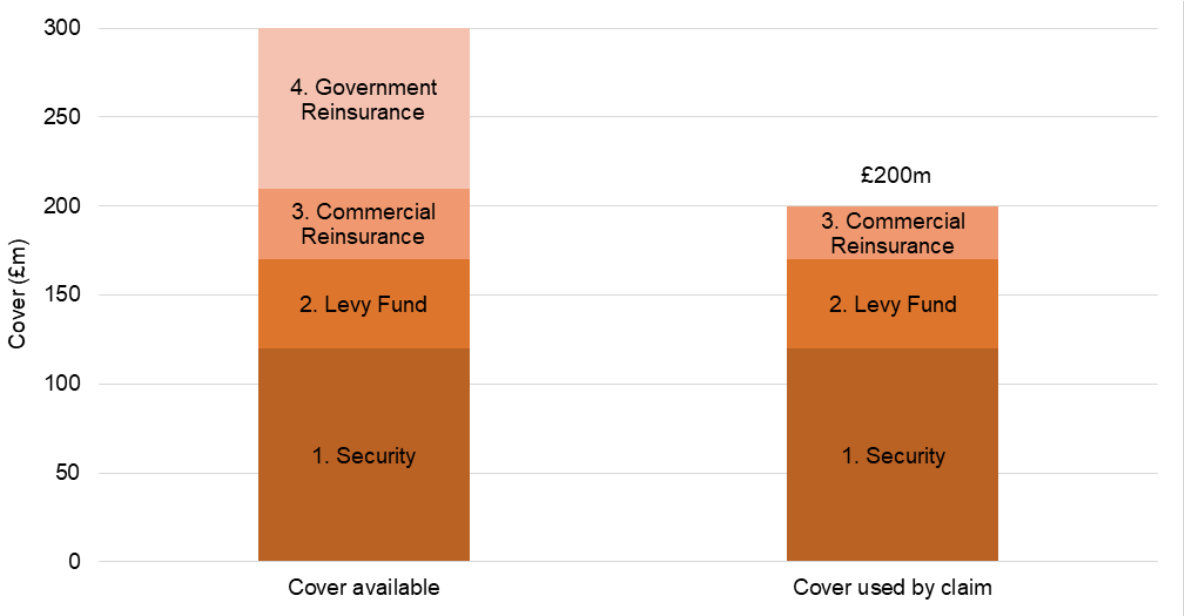


D.7 In this example the cost of repatriation is much higher (£45m) for Package Airlines than in Example 1 as it becomes insolvent at high season. In this situation the full security layer of cover, of £18m is used. In addition, part of the levy fund is also

required to fund the remaining £27m cost of repatriation. £23m of the levy fund is left to cover other claims.

Example 3 – Fly World Airlines becomes insolvent

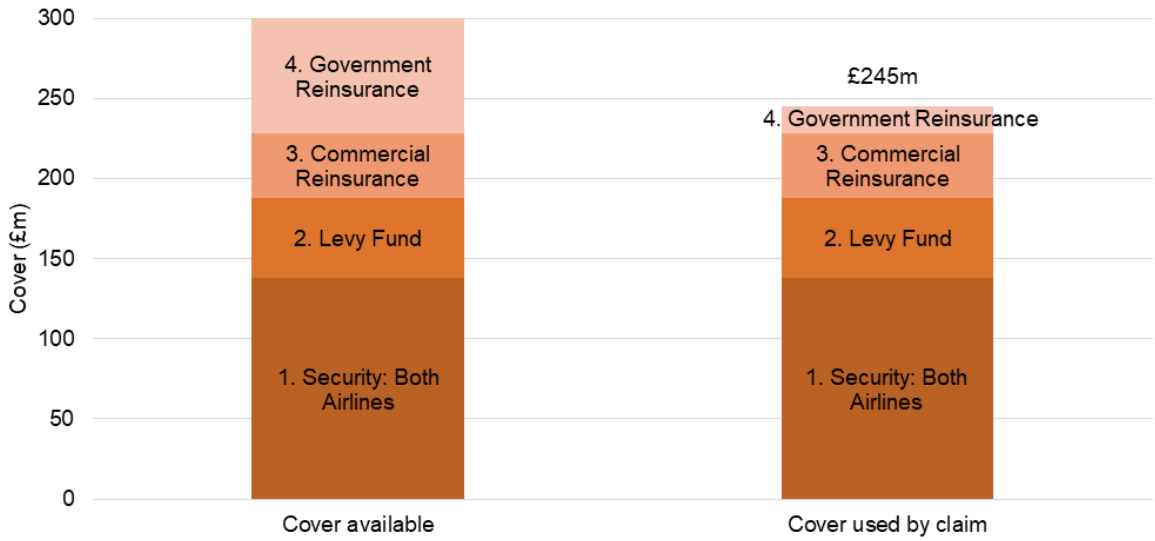
Chart D3 – The cover for Fly World Airlines with a cost of repatriation of £200m



D.8 As Fly World Airlines is a much bigger airline than Package Airlines it is expected that the cost of repatriation will also be higher. In this example the first three layers of cover are all required to meet the £200m cost to repatriate the passengers. Firstly, the full security layer of cover of £120m is used. Next the full amount of the levy fund of £50m is used. Finally, part of the commercial reinsurance layer is also required to pay the remaining £30m repatriation cost.

Example 4 – Package Airlines and Fly World Airlines become insolvent

Chart D4 – The cover for Package Airlines and Fly World Airlines with a total cost of repatriation of £245m



D.9 This is an example of the insolvencies in examples 2 and 3 happening in the same year: repatriation costs for Package Airlines come to £45m, and for Fly World come to £200m. All four layers of cover are required in order to pay the claims. The full security layer for both airlines, namely £138m (£120m + £18m), the full amount of the levy fund (£50m) and the full commercial reinsurance layer (£40m) are required to meet the first £228m of the cost. However, in this example the government reinsurance layer is also required to fund the remaining £17m cost of repatriation.

Example 5 – Fly World Airlines becomes insolvent at low and at high season

Chart D5 – The cover for Fly World Airlines with a total cost of repatriation on insolvency at low season of £100m and at high season of £300m

D.10 At low season only the first layer of cover is required. The cost to repatriate all of the passengers is £100m. This is less than the upper limit of the security layer of cover (£120m) so no additional cover is required to meet the full cost of repatriation and the levy fund is untouched.

D.11 At high season all four layers of cover are required in order to pay the claims. The cost to repatriate all of the passengers is £300m. The full security layer (£120m), the full amount of the levy fund (£50m) and the full commercial reinsurance layer (£40m) are required to meet the first £210m of the cost. However, in this example the government reinsurance layer is also required to fund the remaining £90m cost of repatriation.