THE EUROPEAN UNION SOLIDARITY FUND ASSESSING ITS RISK OF DEPLETION DUE TO CATASTROPHE FLOOD EVENTS

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Abstract:
The European Union Solidarity Fund was created for the purpose of financing measures to alleviate non-insurable damages. The 1 billion Euro Fund can be mobilized if the direct losses of a natural disaster event exceeds 3 billion Euro in 2002 prices or 0.6 percent of GNI of the State in question. The paper examines the risk of depletion of this Fund due to catastrophic flood events in Europe based on a stochastic modeling approach. For this purpose newly available risk based loss estimates for European member countries are used. The results suggest that the fund is likely to be underfunded and concludes with recommendations to make it more robust for the future.

Key words: *European Solidarity Fund, catastrophe floods, robustness, stochastic modeling approach, risk based*

JEL classification: *O52, C15, C53*

1) Introduction

Economic losses due to natural disaster events in European countries as well as on the European scale can be extraordinarily high, especially for flood related events. For example the “Odra Flood” in 1997 in Czech Republic, Germany, Poland and Slovakia caused more than 5 billion Euro losses in total. Furthermore, approximately 300 000 people had to be evacuated due to the event. The floods in August 2002 in Austria, Czech Republic, Germany and Slovakia caused more than 14.4 billion Euro economic losses and more than 400 000 people were affected (EEA, 2003). The huge losses in 2002 persuaded the European Union to establish a fund to help countries in financing its losses due to major disaster events. In the following a short introduction of this fund is given.

The European Union Solidarity Fund (EUSF) was created after the summer 2002 and entered into force on 15 November 2002. Member states and countries which have applied for accession can request aid in the event of a major natural disaster. It provides financial aid for emergency measures in the event of a natural disaster causing direct damages above 3 billion Euros (at 2002 prices) or 0.6 percent of GNI (Council Regulation 2002, Article 2.2). Furthermore, 25 percent of the Fund must be available for allocation during the last quarter of the year (Council Regulation 2002, Article 4.2). The fund can be mobilized even if the threshold is not met, e.g. for a neighboring State that is affected by the same major natural disaster or for extraordinary regional disasters which affects the majority of the population of a region and have serious effects on its economic stability and living conditions. The payments from the Fund are limited to finance operations undertaken by the public authorities alleviating non-insurable damages, e.g. putting infrastructures back in operation (Council Regulation 2002, Article 3).

The European Commission decides the amount of aid and proposes its mobilization. The maximum annual budget is 1 billion Euros per year. The amount available annually for extraordinary regional disasters is also limited to 7.5 percent of the EUSF’s annual budget. A country affected by a disaster receives a lower rate of aid of 2.5% for the part of total direct damage below the “major disaster” threshold and a higher share of aid of 6% for the part of the damage exceeding the threshold (Commission Report, 2004). The procedure of applying for the fund is as follows. The national authorities submit an application to the European Commission no later than 10 weeks after the first damage. Then the Commission assesses the application and decides whether or not and how much of the fund is used. The aid is paid out in a single installment after the signing of an implementation agreement with the beneficiary State and should be used within one year after the date of receipt, any part of the grant remained unused by the date shall be recovered by the Commission. No later than six months the beneficiary state shall present a report on the financial execution of the grant (Council Regulation 2002, Article 8).

While the annual amount of 1 billion Euros for the EUSF seems to be large and annual payments from the fund never exceeded this amount, the risk of depletion of the EUSF was not examined yet from a probability based perspective. Indications that there could be problems already emerged in the very beginning of the EUSF were one single event depleted the fund by more than 75%, namely the flooding in 2002. Furthermore, there is an ongoing discussion to change the threshold levels to 1 billion Euros and 0.5 percent of GDP and enlarging the scope to incorporate also industrial disasters, public health emergencies and terrorism (MEMO 06/153 2006). However, problems could arise if the scope and therefore the possibility of payments from the fund is enlarged but the annual amount is not. This paper shed some light on these issues by providing risk based annual payment distributions of the EUSF which can be used to determine sustainable funding levels for the EUSF to increase robustness now and in the future.

The paper is organized as follows. Section 2 gives a short summary of the past performance of the EUSF, especially for flood related type of events, by analyzing the number of applications and payments from the fund. Section 3 explains the proposed methodology which is based on loss distributions on the country level for European member countries and presents corresponding results. Section 4 ends with a discussion of the risk of the EUSF now and in the future to be depleted and gives recommendations to increase the robustness.

2) Past Performance of the EUSF

This section summarized past experience with the EUSF from 2002 till 2008 with a special focus on flood related type of events. Table 1 gives a summary of the number of applications received as well as the number of successful and rejected applications separated into the three criterions “major disaster”, “regional disaster” and “neighboring country.

Table 1: Type of applications from 2002-2007

	2002	2003	2004	2005	2006	2007	Total (%)
Total Number of Applications	4	10	11	12	4	4	**45 (100)**
- Major	3	2	0	8	1	3	17 (37)
- Regional	1	7	11	3	3	1	26 (58)
- Neighbor	0	1	0	1	0	0	2 (5)
Number of Successful Applications	4	6	1	10	2	4	**27 (60)**
- Major	3	2	0	8	1	3	17 (38)
- Regional	1	3	1	1	1	1	8 (18)
- Neighbor	0	1	0	1	0	0	2 (4)
Number of Rejected[1] Applications	0	4	10	2	2	0	**18 (40)**
- Major	0	0	0	0	0	0	0 (0)
- Regional	0	4	10	2	2	0	18 (40)
- Neighbor	0	0	0	0	0	0	0 (0)

Source: Report from the Commission - European Union Solidarity Fund - Annual report 2004 COM/2005/0709 final. European Union Solidarity Fund - Annual report 2002-2003 and Report on the experience gained after one year of applying the new instrument COM/2004/0397 final, EC 2006, MEMO/06/153, April 2006, IP071885, IP08544, IP071301.

While the number of regional disaster applications is the highest, in contrast to the major disaster group were no application was rejected ever, the number of successful applications is low: from the total number of 26 regional disasters, only 8 successfully applied for the fund. Looking at the different types of hazards, including also the rejected applications, flood events represent the largest group with a total amount of 20 applications (44 percent), followed by fire (27 percent), storms (16 percent), earthquakes (4 percent), and singular events such as explosion, oil spill, volcanic eruption and adverse winter weather. Successful applications were in total 14 for floods, 3 for fires, 7 for storms, and for earthquake, volcanic eruption and oil spill one successful application, respectively. The numbers indicate that large scale events such as floods and storms can be considered as the main hazards which can be successfully applied for and causing the highest damages. Annual payments from the fund for the given time period are shown in table 2.

Table 2: Aid granted and payments 2002-2007

	2002	2003	2004	2005	2006	2007	SUM
Payments (mill. Euro)	728	107.1	19.6	98.5	106.4	423.9	1483.5

Source: see Table 1

As already indicated in 2002 the fund was already depleted by 3/4 in the end of August by only one type of hazard event (flooding) and in 2007 nearly 1/2 of the fund had to be used before October. This is another indication that the EUSF may be vulnerable to large scale events such as flooding. Concerning the issue of robustness of the EUSF the time span here is not long enough to make any reliable statements; instead stochastic modeling approaches have to be used.

[1] Including withdrawn applications

3) Risk of Depletion due to Catastrophe Flood Events

To assess the level of risk the EUSF is exposed to due to flood events in Europe, one can either rely on (i) average estimates or (ii) distributions. Up to now only average country losses based on the past performance of the fund (CEA, 2007) or based on adding up average losses on the GRID level to the national level (Feyen et al., 2009) were available. While such average loss estimates can shed some light on the average risk, they can not be used for assessing risk in a probability based manner. The main advantage of a probability based approach is that the full spectrum of possible payments and corresponding probabilities can be looked at. From such an approach one can estimate also the fat tails of the payment distribution, i.e. the extreme risks. The approach used in this paper can be seen in figure 1.

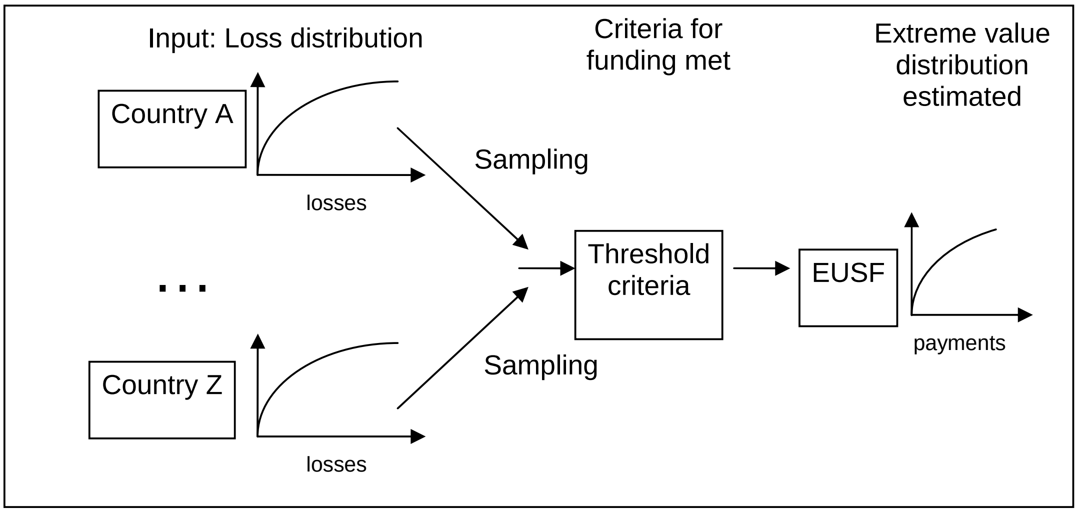

Fig. 1: Approach used for estimating the risk of depletion due for the EUSF

As an input variable, loss distributions for each European member country are used. Based on a sampling algorithm losses are drawn from these distributions and analyzed according to the threshold criteria of the EUSF, i.e. only those disasters are looked at which caused direct damages above 3 billion Euros (at 2002 prices) or 0.6 percent of GDP. If the loss exceeds the threshold then the amount of monetary help from the EUSF is calculated, i.e. they receive a lower rate of aid of 2.5% for the part of total direct damage below the threshold and a higher share of aid of 6% for the part of the damage exceeding the threshold. Both values are added up to obtain the total aid payments for the given country. The payments are used to estimate an extreme value distribution to assess the risk of depletion and for looking into other risk measures as well. Recall, an extreme value distribution is defined by

$$H_{\xi}(x) = \begin{cases} \exp\{-(1+\xi x)^{-1/\xi}\} & \text{if } \xi \neq 0 \\ \exp\{-\exp(-x)\} & \text{if } \xi = 0 \end{cases}$$

where $1+\xi x > 0$. The related location-scale family $H_{\xi,\mu,\sigma}$ can be introduced by replacing the argument x above by $(x-\mu)/\sigma$. The parameter ξ is called the shape parameter. The type 2 (Fréchet) and type 3 (Weibull) classes of extreme value distribution correspond respectively to the cases $\xi > 0$ and $\xi < 0$, while Gumbel arises in the limit as ξ tends to zero (Embrechts et al., 1997).

Loss distributions on the country scale are derived from Lugeri et al. (2009). Basically, their modelling approach combines, by overlay mapping, three main components of risk: flood hazard based on the LISFLOOD model, exposure based on Corine Land Cover maps and physical vulnerability based on flood-depth damage curves. Afterwards, the GRID based loss estimates were up-scaled to the national level to obtain loss distributions on the national scale. To incorporate modeling uncertainty, e.g. height difference uncertainty within the LISFLOOD model, minimum and maximum loss values were calculated for three different starting parameters. This means that at the very end for each country 6 loss distributions were generated, representing uncertainty range within the modeling approach. In this paper the average of the min max values are used to obtain only three distributions, which makes comparison easier, but still reflects the uncertainty within the estimates. Each of these distributions has an order in the sense that one is stochastic dominant over the other. Hence, the distributions still can be interpreted as uncertainty ranges. To avoid confusion, the distribution lying in the middle (as in Lugeri et al., 2009) is referred to as the baseline case and the other two are called upper and lower scenario.

Regarding sampling, a Monte Carlo type of sampling procedure was used based on the well known inverse transformation method. Rather high sampling rates (1.000.000 samples for each country) are chosen so that also very extreme losses are drawn from the distribution. Furthermore, it is assumed that flood events happen independently in each country. This is due to the fact, that it is not possible to quantify the correlation of flood events over more than one country. Hence, the results may be too optimistic, which should be kept in mind for the discussion.

Based on the simulation the average annual payment from the fund for the baseline case is found to be around 380 million Euro with a standard deviation of 1330 million. Hence, it can already be seen that averages seem to be inappropriate to determine the risk of depletion. For the other two type of input distributions the average is around 120 million Euro (standard deviation: 304 million) and 680 million (standard deviation: 1140 Euros) respectively. Extreme value distributions are estimated using maximum likelihood techniques and are shown in figure 2.

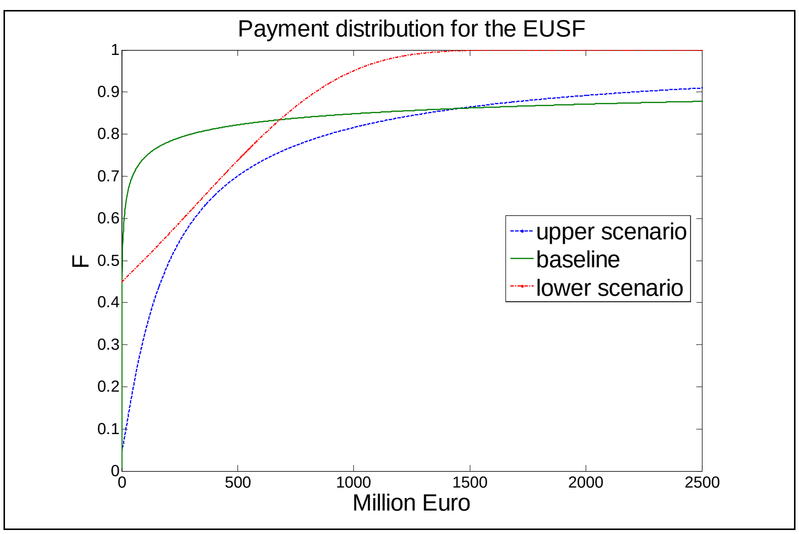

Fig. 2: Payment distribution for the EUSF

For the baseline case a Fréchet distribution with ξ=3.9422 and location parameter μ=3.1886 and scale parameter σ=0.8072 was estimated. A Gumbel distribution was estimated for the lower scenario with location parameter μ=320 and scale parameter σ= 617. For the upper scenario again a Fréchet distribution was estimated with shape parameter ξ =1.1657, μ=190 and σ= 120. Hence, the baseline case has fatter tails compared to the other two and crosses the Gumbel distribution earlier then the Frechet distribution of the upper scenario.

Based on the parameter estimates one can now determine the probability that the fund will not be able to finance all losses it is responsible for, e.g. annual payments are higher than 1 billion Euros. For the baseline case the probability that payments are smaller or equal this amount is 85 percent. In other words, on average, every 7 years one can expect that the EUSF can not meet its obligations. Using the lower scenario the probability would be 95 percent, which means that on average every 20 years the Fund would not be able to meet its obligations. Reversing the question one could ask what the budget of the EUSF should be so that with 95 percent probability payments from the EUSF are guaranteed. For the baseline case the funding would have to increase nearly 10 fold to more than 9.5 billion Euros. For the upper scenario it would have to increase more then 5 fold to around 5.1 billion Euros. For the lower scenario the funding for flood events would be sufficient. It should be kept in mind that due to the high uncertainties of the input distributions these results have to be treated with caution.

4) Discussion

This paper proposed a probability based approach for assessing the robustness of the European Solidarity Fund. While past analysis mostly concentrated on average losses either based on time-series or modeling approaches, the analysis here showed that such numbers may be misleading because they do not incorporate extremes nor the full spectrum of losses possible. Based on newly available loss distributions on the country level for all European member countries a methodology how a risk based assessment of the EUSF could be performed was presented. Furthermore, based on the proposed methodology a payment distribution for the EUSF was estimated to determine the probability of depletion of the Fund due to flood events in Europe. It was found that on average every 7 years one could expect such an event. For a very optimistic scenario depletion occurs on average every 20 years. However, the paper only analyzed flood related hazards and neglected other important large scale hazards such as Storms. As already indicated storm events can cause especially high losses because they can affect large areas at once. For example, the storm "Kyrill" in Germany caused direct losses up to 4.7 billion Euros and the EUSF assisted with more than 166 million Euros. Hence, the results suggest that even in the very optimistic case the European Union Solidarity fund is likely to be underfunded. There is additionally one limitation within the presented approach which could lead to an underestimation of the risk, e.g by neglecting flood events over more than 1 country simultaneously. In a hypothetical example, one could assess the total losses due to 100 year floods in Czech Republic, Germany and Slovakia happening at the same time. This would result in more then 4 billion losses in total and could easily tighten the remaining budget of the EUSF for other hazard events, especially in the light that 25 percent of the fund must be available for allocation during the last quarter of the year.

The risk of depletion could be decreased in several ways, most importantly by (i) diverting money from other sources in the case of depletion (ii) an increase of the yearly budget for the fund or (iii) reinsuring the EUSF. Each of the measure has its pros and cons. While (i) would not cause any additional costs, it could be very difficult to get the money within a short time frame from other sources. This would contradict the main reason of the fund, e.g. "... to respond in a rapid, efficient and flexible manner to emergency situations ..." (Council Regulation 2002, Article 1). The other option (ii) would be more costly but would greatly increase the robustness of the fund. One way to decrease the annual costs could be to accumulate the fund over time. However, there is the problem that accumulation may be too slow to prevent depletion over time and/or it could be underfunded for serious of events over a short time horizon, e.g. 2 to 3 years (see for a discussion Hochrainer, 2006). Lastly, (iii) the EUSF could be reinsured for the case of depletion. However, for such an instrument to be implemented also the other hazards would need to be included in the analysis as presented in this paper. But this has not happened yet, mainly due to the complexity of the problem to estimate accurately the losses of other hazards in a risk based manner. Hence it seems to be the best way forward to start with a version of option (ii), e.g. accumulating the fund instead of keeping it at the 1 billion threshold level. Further analysis should here include a more detailed analysis of the uncertainty of the input data and corresponding results within a dynamic risk management model, e.g. by analyzing the performance of different risk management instruments over time.

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