UNIVERSITÄT BIELEFELD

Faculty of Business Administration and Economics

Working Papers in Economics and Management

No. 04-2020
June 2020

How to spend 750 billion euro? Applying sacrifice theory to determine Covid-19 compensations in the EU

Alfred Greiner   Benjamin Owusu

Bielefeld University
P.O. Box 10 01 31
33501 Bielefeld − Germany

ISSN 2196-2723

→ www.wiwi.uni-bielefeld.de

How to spend 750 billion euro? Applying sacrifice theory to determine Covid-19 compensations in the EU

Alfred Greiner Benjamin Owusu*

Abstract

In this note we consider an economic union consisting of sovereign national states. An asymmetric shock hits the union and as a result it decides to set up a fund in order to compensate the countries in the union. We show how sacrifice theory can be used to determine the compensation payments for the countries in a way such that the relative damages after compensation are equal across countries. Finally, we apply our results to determine the Covid-19 compensation payments in the EU.

JEL: H12, H84

Keywords: Public transfers, sacrifice theory, economic union

*Department of Business Administration and Economics, Bielefeld University, P.O. Box 100131, 33501 Bielefeld, Germany, e-mail: agreiner@uni-bielefeld.de, benjamin.owusu@uni-bielefeld.de

1 Introduction

According to the EU Commission, the 'Next Generation EU' program is intended to help Member States to address the challenges caused by the Covid-19 pandemic. Thus, the EU Commission wants to compensate losses brought about by Covid-19 and to bring back the economies to durable growth. The fund comprises 750 billion euro and is generated by issuing debt on behalf of the EU (see European Commission, 2020).

When allocating the resources across EU Member States, possible criteria could be the losses in GDP caused by Covid-19 or a combination of the losses in GDP and of the rise in unemployment, as suggested by Heinemann (2020). There, a simulation has been performed demonstrating how the funds would be allocated if those criteria were resorted to. The use of those criteria can be justified by models for fiscal insurance systems that posit that payments are guided by either fluctuations in growth or by unemployment.

In this note we follow a different approach. We resort to sacrifice theory (see e.g. Lentzi, 2008) to determine the allocation of resources from a joint fund in an economic union that has been set up in order to compensate the damages caused by an exogenous shock that hits the economies in an asymmetric manner. Often, sacrifice theories are resorted to in order to implement the ability-to-pay principle that is used as a justification for income taxation. A sacrifice is considered as a reduction of utility due to the tax that reduces disposable income of an individual. Typically, three different concepts are distinguished: the concept of the same absolute sacrifice, the concept of the same proportional or relative sacrifice and, finally, the concept of the same marginal sacrifice.

The concept of the same absolute sacrifice requires that each individual makes the same sacrifice in terms of the same reduction of its utility[1] as a result of the tax. This implies that the decline in utility relative to utility before taxation is smaller the higher the initial level of utility is, when the marginal utility declines and the reduction in utility is the same for all in the case of a constant marginal utility, giving a lump-sum tax. Generally, this is considered as unfair by most societies. Nevertheless, a justification for

[1]The utility function is assumed to be identical for all individuals, rising in the income and continuously differentiable with a declining or constant marginal utility.

that principle can be seen in the argument that each individual in an economy benefits to the same degree from non-rivalrous public goods provided by the government so that it is justified to contribute in the same way to its financing. Thus, this principle is based on the approach of the 'justitia commutativa' (see Haller, 1973).

The same relative sacrifice is given when the decline in utility, due to income taxation, relative to utility before taxation is the same for all individuals. With this concept, individuals with a higher initial level of utility bear a higher reduction of their utility in absolute values. With a constant marginal utility this leads to a proportional tax rate, with a declining marginal utility this gives a proportional or progressive tax rate, depending on the functional form of the utility function. Consequently, individuals with higher incomes and, thus, higher utility before taxation pay higher taxes compared to what they would have to pay if the concept of the same absolute sacrifice was applied. The basis for the same relative sacrifice can be seen in the idea of an 'justitia distributiva'.

The same marginal sacrifice finally implies that the incomes after taxes are identical for all taxpayers when the marginal utility declines, implying a progressive tax scheme of the highest degree, while it is indeterminate in the case of a constant marginal utility. This concept results from the maximization of the sum of individual utilities with respect to the tax of each individual, i.e. from welfare maximization, and minimizes the total tax burden. However, its relevance for real world economies is rather limited because it has severe shortcomings, such as the neglect of incentive problems and the assumption that the incomes of the individuals are given in the optimization process.

In the rest of this note we proceed as follows. In section 2, we apply the concept of the same relative sacrifice to determine the allocation of resources to the countries within an economic union that have been hit differently by an exogenous shock. Section 3 uses the theoretical results to compute the compensations for the EU 27 where we take preliminary estimates for the damages caused by Covid-19. Section 4, finally, summarizes our results and concludes the note.

2 Theoretical results

We consider an economic union consisting of n sovereign states. An asymmetric shock hits the economies of the union causing damages S_i^v, $i = 1, \dots, n$, in the countries with $S^v = \sum_{i=1}^n S_i^v$. The union sets up a fund with a total amount of Z that is distributed to the economies where each country receives Z_i, $i = 1, \dots, n$, with $Z = \sum_{i=1}^n Z_i$. As regards the allocation of the resources from the fund we posit that the union wants to avoid any discrimination implying that each economy makes the same sacrifice after having received its compensation from the fund. In the introduction we have discussed the three sacrifice concepts. The concept of the absolute sacrifice would imply that the per capita GDP in each country is reduced by the same amount. This neglects the fact that richer countries can bear higher loads than poorer economies and would very likely not be accepted unanimously. A more plausible approach is the concept of the same proportional sacrifice that has gained broader acceptance.

Therefore, the union decides to allocate the resources from the fund in a way such that the damages after compensation payments, S_i, $i = 1, \dots, n$, are equal according to the concept of the same relative sacrifice, i.e.

$$\frac{Y_1^v - (Y_1^v - S_1)}{Y_1^v} = \frac{Y_2^v - (Y_2^v - S_2)}{Y_2^v} = \dots = \frac{Y_n^v - (Y_n^v - S_k)}{Y_n^v}$$

holds, with Y_i^v GDP in country i, $i = 1, \dots, n$, before the shock. All variables are nominal and measured in euro and we assume $Z_i < S_i^v < Y_i^v$. We should like to point out that we do not assume a concave utility function giving utility in an economy as a function of GDP with a declining marginal utility. The use of a strictly concave utility function may be justified when considering individuals, although it often is disputed even in this case, but, for entire economies it is not justified to assume a decreasing marginal utility of GDP. This holds because in each country there exist quite a many poor people who would benefit from higher incomes and even in rich countries there is a broad scope for public investment projects that would raise productivity and/or the well-being of the people.

Proposition 1 shows how the sacrifices after compensation are distributed and determines the allocation of resources when the concept of the same proportional sacrifice is applied.

Proposition 1 *Assume that the damages after compensation payments should be equal according to the concept of the same proportional sacrifice and let* $I = \{j \in \mathbb{N} | 1 \leq j \leq n\}$. *Then, the damages after compensation are given by*

$$S_k = (S^v - Z) \left(\frac{Y_k^v}{\sum_{i \in I} Y_i^v} \right), \; k = 1, \ldots, n.$$

Further, compensation payments are determined as

$$Z_k = Z \left(\frac{Y_k^v}{\sum_{i \in I} Y_i^v} \right) + S_k^v \left(\frac{\sum_{i \in I \setminus \{k\}} Y_i^v}{\sum_{i \in I} Y_i^v} \right) - \left(\frac{Y_k^v}{\sum_{i \in I} Y_i^v} \right) \left(\sum_{i \in I \setminus \{k\}} S_i^v \right), \; k = 1, \ldots, n.$$

Proof: See appendix A. □

Proposition 1 shows that the damages in an economy, after compensation, relative to total damages just equal its GDP before the shock relative to total GDP, i.e. the relative damage after compensation is equal to its share of GDP in the union before the shock. Thus, countries with a higher relative share in total GDP bear higher burdens, as was to be expected.

The compensation payment a country receives is given by the overall amount of the fund multiplied by its share in total GDP plus its damage before compensation multiplied by the sum of the GDP of all other economies relative to the total GDP of all economies minus the damage of all other countries multiplied by the relative GDP share of the country under consideration. The compensation payment a country receives is not as intuitive as the sacrifice after compensation it has to make, but, can be easily derived once its sacrifice has been determined (see the proof in the appendix A).

It can be realized that the payment depends on a component that is independent of the damages, the total amount of the fund, and on two components that depend on the shock, the country's own damage and the damages of all other countries. The payment is the higher the larger is the fund and the higher is the share of that country's GDP relative to the total GDP of all economies. Thus, this first term favors rich countries with a high GDP. Further, a country receives the more the more it was hit by the shock and the lower the damages of all other economies in the union are, ceteris paribus.

3 Application to the 'Next Generation EU' program

To compute the compensations for the EU 27 countries, we recall the theoretical results from proposition 1. GDP for 2019 was used as the proxy for GDP before Covid-19 and the data was obtained from the Eurostat website (cf. Eurostat, 2020). Regarding the damage before Covid-19, we used GDP growth contractions for 2020 and obtained the data from the European commission spring forecast for April 2020 (see European Commission, 2020a). Figure 1 and figure 2 provide a pictorial view of the GDP before Covid-19 and of the damages in terms of GDP losses as a result of Covid-19.[2] From Figure 1 it can be seen that the loss is somehow proportional to the level of GDP. However, Italy, Spain and France experienced a high proportionate loss as compared to the other large EU economies. From Figure 2, we notice that Greece, Croatia, Hungary and Lithuania recorded the highest losses in terms of GDP due to Covid-19 in the group of the smaller EU economies.

Next, we proceed to apply the principle of the same proportional sacrifice to calculate the compensations, the damages after compensation and the relative damages after compensation for each individual country. As it stands now there has not been a clear communication as to how the funds would be distributed. However, the discussions suggest that 500bn out of the total 750bn will be distributed as grants whilst the additional 250 will be disbursed in the form of loans. We compute the two equations from proposition 1 considering two scenarios: firstly, we look at the scenario with the total compensation amount of 750bn spent according to the same relative sacrifice and, then, we consider the situation with a compensation of 500bn distributed according to that principle. We do so because, on the one hand, one can argue that the payments are to compensate for the Covid-19 damages, independent of how they are financed. In this respect, one would adopt a purely static view. On the other hand, one could argue that 250bn have to be paid back by the recipient countries in the future so that they have to cover that part of

[2]The figure was split into two parts, large EU economies and small EU economies. This is to avoid scaling problems due to the high GDP of some countries relative to others.

the damage by themselves, implying that it does not reduce losses.

Figure 1: EU GDP 2019 and damages due to Covid-19 (large EU economies)

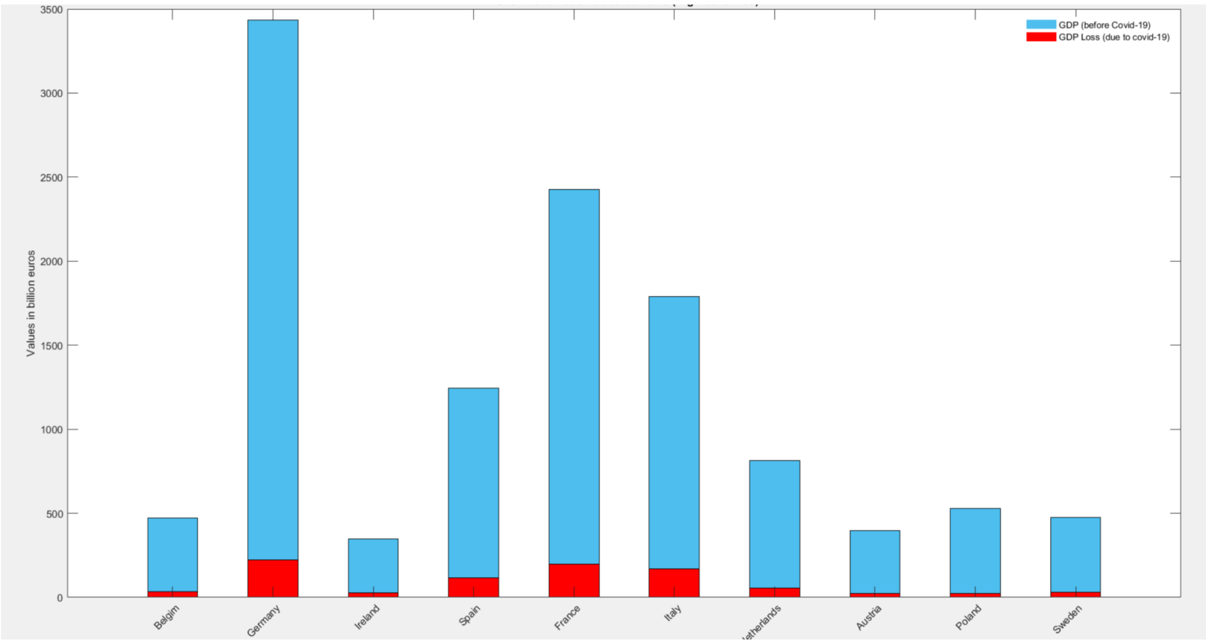

Figure 2: EU GDP 2019 and damages due to Covid-19 (small EU economies)

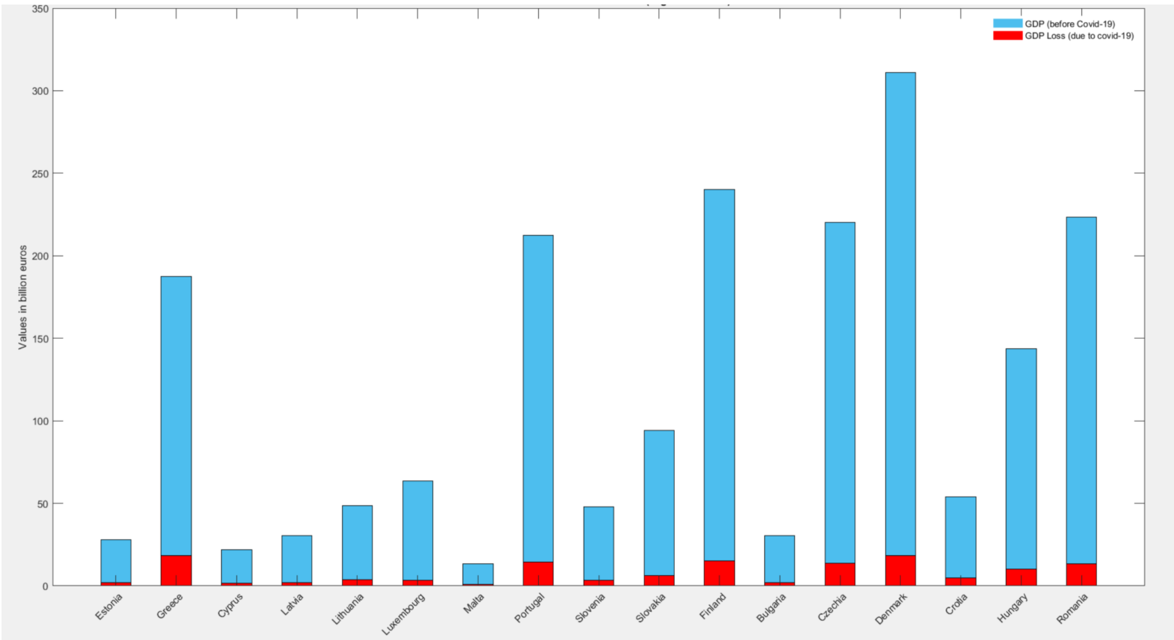

Table 1 presents the computation of the compensation payments using the concept of the same proportional sacrifice with the results from proposition 1. Recall that Y_i^v denotes the GDP before the Covid-19 shock, S_i^v is the damage to GDP caused by Covid-19, Z_i represents the compensation payment according to the same relative sacrifice principle, S_i gives damages after compensation and S_i/Y_i^v is the relative damage after compensation. In the table 1 we report losses, $L_i = -S_i$, in order to point out that these reduce the GDP in the economies under consideration. The compensation payments have been calculated such that all countries bear the same relative burden or damages according to the concept of the same proportional sacrifice. This is can be seen from table 1 (column 4 and column 6) considering total compensation package of 750bn and 500bn, respectively. Further, in both instances the relative damages after compensation are equal for all countries as can be seen from columns 5 and 7 in table 1. Hence, the concept of equal proportional sacrifice is fulfilled.

Table 2 provides an overview of our proposed compensation allocation relative to the GDP before Covid-19. In other words, we computed the ratio of the compensation

Table 1: Compensations and losses before ($L_i^v = -S_i^v$) and after ($L_i = -S_i$) compensation.

Countries	Y_i^v	L_i^v/Y_i^v	Z=750bn		Z=500bn	
			Z_i	L_i/Y_i^v	Z_i	L_i/Y_i^v
Belgium	473.09	-0.072	24.37	-0.02	15.88	-0.04
Germany	3,435.21	-0.065	152.93	-0.02	91.28	-0.04
Estonia	28.04	-0.069	1.36	-0.02	0.86	-0.04
Ireland	347.22	-0.079	20.32	-0.02	14.09	-0.04
Greece	187.46	-0.097	14.34	-0.02	10.98	-0.04
Spain	1,245.33	-0.094	91.56	-0.02	69.20	-0.04
France	2,425.71	-0.082	149.23	-0.02	105.69	-0.04
Italy	1,787.66	-0.095	133.22	-0.02	101.13	-0.04
Cyprus	21.94	-0.074	1.17	-0.02	0.78	-0.04
Latvia	30.48	-0.070	1.51	-0.02	0.96	-0.04
Lithuania	48.43	-0.079	2.83	-0.02	1.96	-0.04
Luxembourg	63.52	-0.054	2.13	-0.02	0.99	-0.04
Malta	13.28	-0.058	0.50	-0.02	0.26	-0.04
Netherlands	812.05	-0.068	38.59	-0.02	24.01	-0.04
Austria	398.68	-0.055	13.76	-0.02	6.61	-0.04
Portugal	212.32	-0.068	10.09	-0.02	6.28	-0.04
Slovenia	48.01	-0.07	2.38	-0.02	1.52	-0.04
Slovakia	94.17	-0.067	4.38	-0.02	2.69	-0.04
Finland	240.08	-0.063	10.21	-0.02	5.90	-0.04
Bulgaria	60.68	-0.072	3.13	-0.02	2.04	-0.04
Czechia	220.20	-0.062	9.14	-0.02	5.19	-0.04
Denmark	310.94	-0.059	11.98	-0.02	6.40	-0.04
Croatia	53.94	-0.091	3.80	-0.02	2.84	-0.04
Hungary	143.83	-0.070	7.12	-0.02	4.54	-0.04
Poland	529.03	-0.043	11.91	-0.02	2.42	-0.04
Romania	223.34	-0.060	8.83	-0.02	4.82	-0.04
Sweden	474.15	-0.061	19.21	-0.02	10.70	-0.04

Computation of the losses $L_k = -S_k = (Z - S^v)\left(\frac{Y_k^v}{\sum_{i\in I} Y_i^v}\right)$, $k = 1, \dots, n$. and of the compensations $Z_k = Z\left(\frac{Y_k^v}{\sum_{i\in I} Y_i^v}\right) + S_k^v\left(\frac{\sum_{i\in I\setminus\{k\}} Y_i^v}{\sum_{i\in I} Y_i^v}\right) - \left(\frac{Y_k^v}{\sum_{i\in I} Y_i^v}\right)\left(\sum_{i\in I\setminus\{k\}} S_i^v\right)$, $k = 1, \dots, n$. GDP and compensations are expressed in billion of euros.

payments of individual countries to the GDP before Covid-19. It can be observed that countries with higher GDP losses, such as Spain, Italy, Greece and France with a loss above 8%, receive compensations of more than 7% relative to their GDP in 2019. This is higher than the compensations for countries such as Denmark, Malta, Poland and Austria who experienced damages (losses) less than 6% of their GDP. Figure 3 gives a further graphical overview of the damages and of the compensations both as a percentage of GDP in 2019. It can be observed that the compensation payments for all individual countries relative to GDP in 2019 amounts to more than half of the damages relative to GDP in 2019. In the end the relative loss (damage) after the compensation package is the same for all countries. We can infer that this principle is therefore not discriminatory in the sense that all countries bear the same relative burden after the compensation package. Indeed, as opined by Neil (2000), the equal sacrifice principle can be considered as a formal characterization of fairness and as a fundamental concept of distributive justice.

Figure 3: Damage due to Covid-19 and compensation (as percentage of GDP 2019)

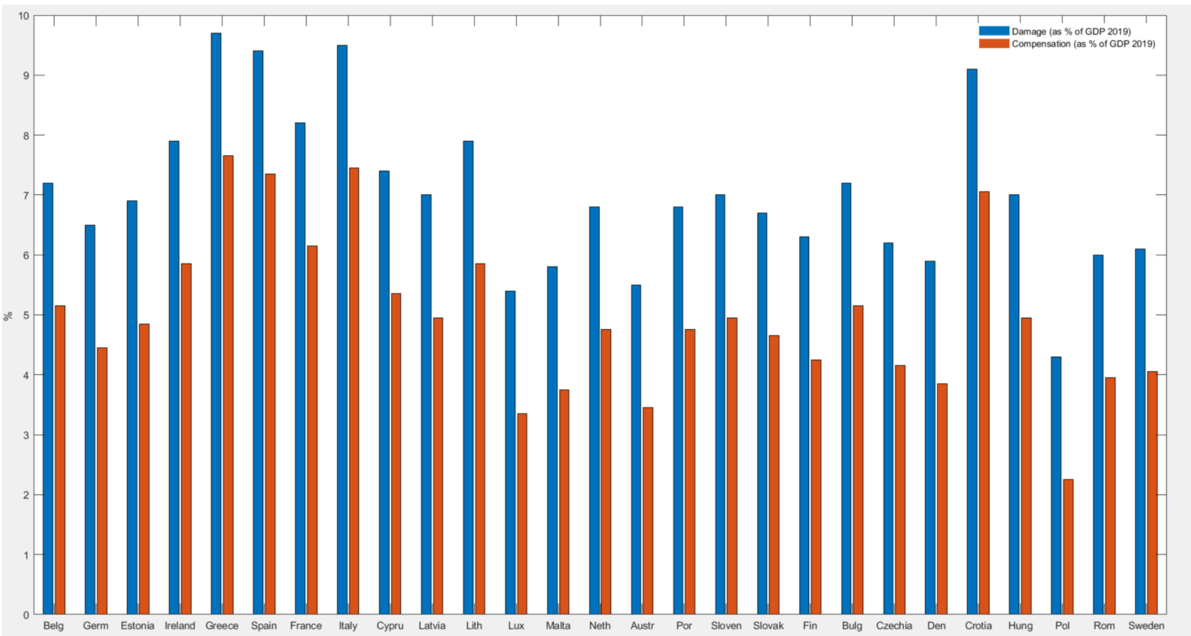

Table 2: Compensation payments as percentage of GDP 2019

Countries	Z=750bn		Z=500bn	
	Z_i	Z_i(%GDP)	Z_i	Z_i(%GDP)
Belgium	24.37	5.2%	15.88	3.4%
Germany	152.93	4.5%	91.28	2.7%
Estonia	1.36	4.9%	0.86	3.1%
Ireland	20.32	5.9%	14.09	4.1%
Greece	14.34	7.7%	10.98	5.9%
Spain	91.56	7.4%	69.20	5.6%
France	149.23	6.2%	105.69	4.4%
Italy	133.22	7.5%	101.13	5.7%
Cyprus	1.17	5.4%	0.78	3.6%
Latvia	1.51	5.0%	0.96	3.2%
Lithuania	2.83	5.9%	1.96	4.1%
Luxembourg	2.13	3.4%	0.99	1.6%
Malta	0.50	3.8%	0.26	2.0%
Netherlands	38.59	4.8%	24.01	3.0%
Austria	13.76	3.5%	6.61	1.7%
Portugal	10.09	4.8%	6.28	3.0%
Slovenia	2.38	5.0%	1.52	3.2%
Slovakia	4.38	4.7%	2.69	2.9%
Finland	10.21	4.3%	5.90	2.5%
Bulgaria	3.13	5.2%	2.04	3.4%
Czechia	9.14	4.2%	5.19	2.4%
Denmark	11.98	3.9%	6.40	2.1%
Croatia	3.80	7.1%	2.84	5.3%
Hungary	7.12	5.0%	4.54	3.2%
Poland	11.91	2.3%	2.42	0.5%
Romania	8.83	4.0%	4.82	2.2%
Sweden	19.21	4.1%	10.70	2.3%

4 Conclusion

In this note we have used the concept of the same proportional sacrifice to determine the compensation payments to countries of an economic union that is hit by an asymmetric shock such that each country has to make the same relative sacrifice after compensation.

We have derived that the damage in each country, after the compensation, relative to the sum of damages equals the share of the country's GDP relative to the sum of the GDP of all economies. Then, we derived the compensation payment in a country and found that it equals the weighted difference of the total fund minus the weighted damages of all other countries plus that country's weighted damage. Finally, we applied our results to the allocation of resources from the 'Next Generation EU' program and computed the compensation each Member States receives, based on preliminary estimates as to the damages caused by Covid-19.

To finish our note we want to point out two aspects that we did not take into account. Firstly, when computing the compensations we did not allow for differences in the price level of the countries. Thus, one euro transferred to Lithuania disposes of a different purchasing power than one euro transferred to Luxembourg, for example. That problem, however, could be easily solved by integrating a price deflator and using real values. Nevertheless, the basic results would still remain the same.

Secondly, when computing the compensations we neglected the fact that the economic capacity of a country does not only depend on its GDP, but on its private and public wealth as well. Hence, in future works one could allow for that aspect by referring the damages to an aggregate of GDP and wealth that is to reflect the economic capacity of a country more accurately.

References

European Commission (2020). *The EU Budget Powering. The Recovery Plan for Europe.* European Union, Brussels, doi:10.2761/712137

European Commission (2020a). *European commission spring forecast*, Spring 2020, European Commission, Brussels, doi:10.2765/788367

Eurostat (2020). *National Accounts Database, Eurostats, Available at https://ec.europa.eu/eurostat/web/national-accounts/data/database* [Accessed: 7 June 2020].

Heinemann, Friedrich (2020). "Simulating the distributive effects of the Macron-Merkel-Recovery fund." *ZEW expert brief 20-07,* ZEW, Mannheim.

Haller, Heinz (1973). "Zur Diskussion über das Leistungsfähigkeitsprinzip." *FinanzArchiv / Public Finance Analysis,* Vol. 31, no. 3, 461-494.

Lenzi, Mary (2008). "Equal Sacrifice Theory". In: Kolb, Robert W. (ed.) *Encyclopedia of Business Ethics and Sciety*, SAGE Publications, Thousand Oaks, doi: http://dx.doi.org/10.4135/9781412956260.n296

Neill, Jon (2000). "The benefit and sacrifice principles of taxation: A synthesis." *Social Choice and Welfare,* Vol.7, 17–124.

A Proof of proposition 1

The concept of the same relative sacrifice implies

$$\frac{S_1}{Y_1^v} = \frac{S_2}{Y_2^v} = \ldots = \frac{S_k}{Y_n^v}$$

Setting $S_1/Y_1^v = S_2/Y_2^v$ and using $S_1 = S - \sum_{i=2}^n S_i$ leads to

$$S_2 = S\left(\frac{Y_2^v}{Y_1^v + Y_2^v}\right) - \sum_{i=3}^n S_i \left(\frac{Y_2^v}{Y_1^v + Y_2^v}\right), \tag{A.1}$$

where $S = \sum_{i=1}^n S_i$. Inserting S_2 from (A.1) in $S_2/Y_2^v = S_3/Y_3^v$ gives

$$S_3 = S\left(\frac{Y_3^v}{Y_1^v + Y_2^v + Y_3^v}\right) - \sum_{i=4}^n S_i \left(\frac{Y_3^v}{Y_1^v + Y_2^v + Y_3^v}\right)$$

Continuing this procedure, we obtain

$$S_{n-1} = S\left(\frac{Y_{n-1}^v}{\sum_{i=1}^{n-1} Y_i^v}\right) - S_n \left(\frac{Y_{n-1}^v}{\sum_{i=1}^{n-1} Y_i^v}\right) \tag{A.2}$$

Inserting S_{n-1} from (A.2) in $S_{n-1}/Y_{n-1}^v = S_n/Y_n^v$ and solving with respect to S_n, finally, leads to

$$S_n = S\left(\frac{Y_n^v}{\sum_{i=1}^n Y_i^v}\right) \tag{A.3}$$

Inserting S_n from (A.3) in (A.2) gives

$$S_{n-1} = S\left(\frac{Y_{n-1}^v}{\sum_{i=1}^n Y_i^v}\right) \tag{A.4}$$

and so on up to S_1. Noting that $S = S^v - Z$ leads to S_k in proposition 1.

To compute compensation payments Z_k, we note that $Z_k = S_k^v - S_k$ holds. Computing Z_n using (A.3) and $S = S^v - Z$, we obtain for country n

$$\begin{aligned} Z_n &= S_n^v - S_n^v\left(\frac{Y_n^v}{\sum_{i=1}^n Y_i^v}\right) - \sum_{i=1}^{n-1} S_i^v\left(\frac{Y_n^v}{\sum_{i=1}^n Y_i^v}\right) + Z\left(\frac{Y_n^v}{\sum_{i=1}^n Y_i^v}\right) \\ &= S_n^v\left(\frac{\sum_{i=1}^{n-1} Y_i^v}{\sum_{i=1}^n Y_i^v}\right) - \sum_{i=1}^{n-1} S_i^v\left(\frac{Y_n^v}{\sum_{i=1}^n Y_i^v}\right) + Z\left(\frac{Y_n^v}{\sum_{i=1}^n Y_i^v}\right) \end{aligned}$$

Proceeding in the same way to compute Z_{n-1} generates

$$Z_{n-1} = S_{n-1}^v\left(\frac{\sum_{i=1}^n Y_i^v - Y_{n-1}^v}{\sum_{i=1}^n Y_i^v}\right) - \left(\sum_{i=1}^n S_i^v - S_{n-1}^v\right)\left(\frac{Y_{n-1}^v}{\sum_{i=1}^n Y_i^v}\right) + Z\left(\frac{Y_{n-1}^v}{\sum_{i=1}^n Y_i^v}\right)$$

Continuing this procedure up to Z_1 demonstrates that Z_k is given by the expression in proposition 1. □