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The calculation of an annuity for increased needs due to personal injury¹

Abstract

A source of personal injury can be e.g. a road traffic accident, a work accident, medical malpractice, etc. This paper discusses the method of calculating an annuity for an accident victim. If an accident victim has suffered bodily injury, the person who has caused the accident should provide the injured person with funds for covering their increased needs. The grounds for such a claim are the civil law, which is applicable in European countries to a similar extent. The increased needs which might arise for an accident victim include for instance: additional costs of doctor appointments, travel to health facilities, medicines and medical equipment, physical therapy, special diet, care, loved ones' travels to the hospital.

The aim of this paper is to present the possible valuation methodology for individual components of such an annuity for increased needs and to propose a consistent valuation model for the current value of such an annuity benefit. The knowledge of the current value of such an annuity is important to the person who is supposed to pay it. And the injured person may also want to know the current value of the annuity because they might choose a one-off payment instead.

1. Introduction - law and literature

The term 'personal injury' has not been clearly defined. This might arise from its multifaceted scope, i.e. related to economics, law, economic analysis of law, or mathematics. However, there are scientific publications which provide the knowledge of this notion². For the purpose of this

¹ Erlier: „The calculation of annuity for the increased needs due to personal injury”

² For instance: W. Czachórski (1994), *Zobowiązania. Zarys wykładu*, PWN, Warszawa, p. 72; L. Green (1955), *The study and teaching of tort law*, Texas Law Review, Vol. 34; T. Karaś (2007), *uwagi na temat pojęcia „szkoda” w amerykańskiej teorii prawa*, Studia Iuridica XLVII, p. 113; J.H. Wigmore (1895), *A general analysis of tort relations*, Harvard Law Review, vol. 8, pp. 378-379.

paper, the definition developed by Dr Hab. Ilona Kwiecień³ will be invoked: “Hence, personal injury may be treated as one of the forms of loss consisting in infringement of personal interests (in broad terms) or violation of bodily and health integrity (in narrow terms), or as a set of the related adverse consequences.” The legal grounds for determining compensation for this type of loss are mainly the Civil Code in Poland – Articles 444–447. Similar provisions can be found in other European Codes, such as in the German: § 249-254, § 842-846 BGB (Bürgerliches Gesetzbuch of 18 August 1896); the French: Articles 1382 of the Civil Code of 21 March 1804 and the British ones: the document Fatal Accident Act and Article 8 of the Human Rights Act of 1998.

The financial significance of personal injury for the insurance sector will be demonstrated here since in particular damages and compensation for pain and suffering disbursed from the third-party liability insurance of motor vehicle owners are the most common source of funding the arisen financial losses. The number of claims related to bodily injury currently constitutes fewer than 13% of all claims in respect of the third-party liability insurance of motor vehicle owners⁴, whereas the value of such claims is nearly half of the total benefits and damages disbursed in respect of this type of insurance in Europe – it was 48.4% of the total amount of the benefits and damages in respect of the third-party liability insurance of motor vehicle owners in 2013, and was similar to that of 2012, yet 5 pp. lower than in 2008. The highest level of damages was recorded in France, Spain, and Italy. The average claim value in European countries in 2013 amounted to circa EUR 16,000 compared to EUR 15,500 in 2012, EUR 14,500 in 2011, and EUR 13,800 in 2010. The average value of the loss arising from the MTPL insurance in Europe increased by circa 20%⁵. The average claim value differs considerably between various countries and, most importantly, it is continuously growing⁶. The greatest growths were

³ I. Kwiecień (2015), *Ekonomiczna analiza dochodzenia roszczeń o zadośćuczynienie za szkody na osobie z ubezpieczeń odpowiedzialności cywilnej*, Wydawnictwo UE we Wrocławiu, Wrocław, p. 17

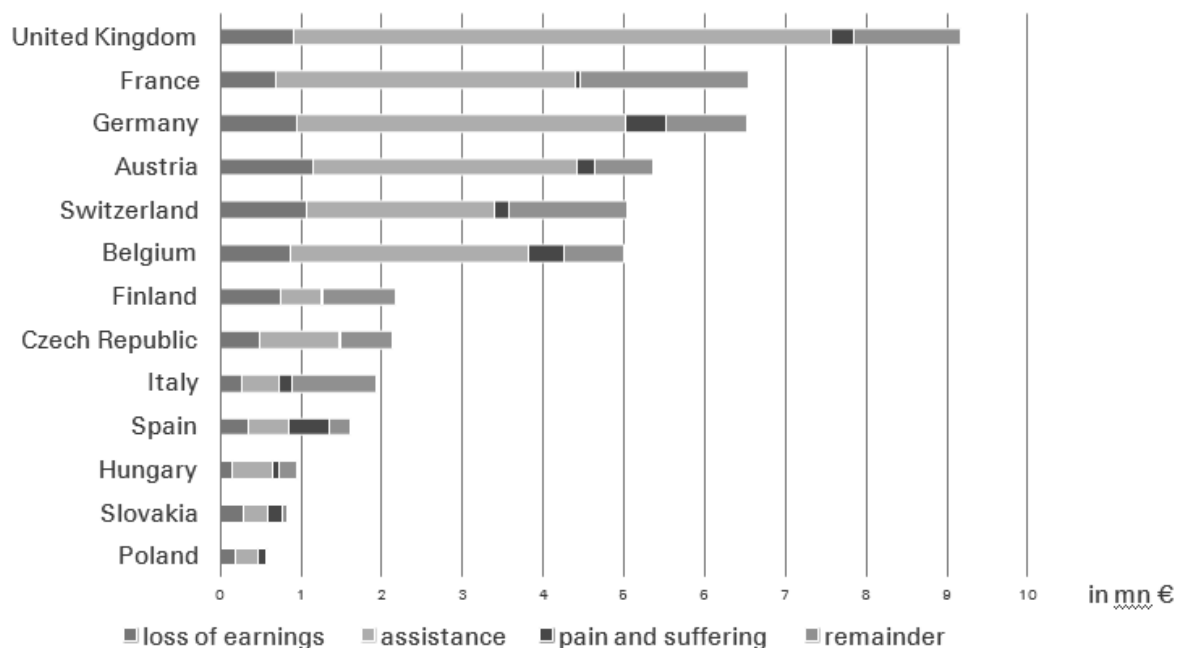
⁴ European Motor Insurance Markets. Addendum, June 2016, Chart 19

⁵ European Motor Insurance Markets. Addendum, June 2016, p. 33

⁶ When studying the relevant literature, one can encounter publications indicating the sources (legal, social, and economic factors) of such trends, e.g. in the study by T. Holzheu, R. Lechner, *Commercial liability: a challenge for businesses and their insurers*, “Sigma” 2009, Issue 5. At the same time, it is emphasised that social attitudes are most significant among the factors – Cf. F. Furedi, *Courting Mistrust: The hidden growth of a culture of litigation in Britain*; Centre for Policy Studies, London 1999; U. Leimbacher *et al.*, *The globalisation of collective redress: Consequences for the insurance industry*, Swiss Re 2009; R. Enz, T. Holzheu, *The economics of liability losses – insuring the moving target*, “Sigma” 2004, Issue 6; J.T. Schmit, *Factors Likely to Influence Tort Litigation in the European Union*, “The Geneva Papers on Risk and Insurance – Issues and Practice” 2009, Issue 31, pp. 304–313; A. Carmignani, S. Giacomelli, *Too many lawyers? Litigation in Italian civil courts*, “Temi di Discussione” Issue 745 (February 2010), <http://www.astrid-online.it/--giustizi/GIUSTIZIA-/Studi--ric/determinanti-litigiosit--BdI.pdf>.

recorded in Greece (55%), Italy (45%), and France (25%) in that period⁷. The highest average claim was recorded in Greece (ca. EUR 33,000), France (ca. EUR 22,000), and Norway (ca. EUR 19,000) in 2013. The lowest average payment amounts were recorded in Czechia (ca. EUR 1,500), Turkey (ca. EUR 4,000), and Estonia (ca. EUR 5,000). When considering the values, it should be noted that the personal injury damages systems significantly differ in individual European countries. This regards among others limits on damages or the possibility to submit new claims if circumstances such as increase in costs of claims arise. However, benefits in respect of personal injury are not uniform. The main components are care costs (they constituted almost 54% of all payments made in the period 2010-2011), medical costs (16.4% of all payments), loss of earnings (9.36%), and compensation for pain and suffering (7.32%). This aspect of the damages amount has still varied between countries. The highest general payment level is noticeable in Great Britain, where EUR 15 million per person can be achieved. It is nearly 9 times as high as in the Netherlands and Spain and 4 times as high as in Italy⁸.

Chart 1. Components of claims in respect of personal injury in selected European countries in 2010



Source: <http://www.swissre.com>

⁷ Motor Insurance and Reinsurance. Current Issues and Future Trends, Scor Global P&C, Focus, February 2015, p. 34

⁸ Motor Insurance and Reinsurance. Current Issues and Future Trends, Scor Global P&C, Focus, February 2015, p. 12

An accident causing bodily injury or health disorders to its victim results in the necessity for the victim to take measures aimed to treat or minimise or eliminate the health impairment suffered (e.g. through physical therapy, the necessary care provided to the injured person), which are determined by increased needs of the injured person under the discussed provision. All needs of that kind mean higher costs for the injured person and it is the person who has caused the loss, and hence the insurance company providing the injuring person with a third-party liability insurance cover, that is obliged to cover such costs. The need to incur specific expenses occurs in the case of more serious injuries, usually over a long time span and, consequently, claiming their reimbursement from the injuring party or their insurer on a weekly or monthly basis would be an excessive nuisance for the injured party, who should concentrate mainly on treatment. Therefore, the legislator decided that, in analogous situations (the necessity to incur costs for a long time), the injured parties are entitled to a claim for an annuity for increased needs.

It is also possible that the injured person's earning capacity has not been lost but their needs have increased, e.g. the person can still work on his or her position but needs to take expensive medicines, undergo physical therapy, observe a specially supplemented diet.

The legal grounds for claiming an annuity from the injuring person or their insurer by the injured person are specified in Article 444 § 2 of the Act of 23 April 1964 Civil Code (Dz. U. no. 16, item 93, as amended): "Where the injured party has lost their earning capacity in whole or in part or where their prospects for the future have diminished, the injured party may claim a suitable annuity from the person obliged to redress the damage."

Therefore, the injured person is entitled to claim an annuity where:

- they have lost their earning capacity in whole or in part;
- their prospects for the future have diminished;
- or their needs have increased.

The third case refers to the option to claim the so-called annuity for increased needs, which is a future loss manifesting in recurring expenses for permanent treatment, surgeries, and physical therapy to achieve improvement or prevent deterioration of the injured person's health, special diet, care by third parties, etc.⁹ The premise for its determination may not be the injured person's cost of living, it may only be damages for the injured party's increased needs as a result of the caused damage to health¹⁰. And, importantly, granting an annuity in respect of increased needs

⁹ Cf. judgment of the Appeal Court in Katowice of 24 May 1996 (file ref. no. III Apr 7/96, OSA 1997, no. 6, item 18).

¹⁰ Supreme Court in its judgment of 20 December 1977, file ref. no. IV CR 486/77, LEX no. 8042.

under Article 444 § 2 of the Civil Code is not contingent upon proving that the injured person actually satisfies the needs and incurs the related expenses. The existence of the injured person's increased needs as a consequence of tort is sufficient for granting an annuity in this respect¹¹. As was indicated by the Supreme Court¹², in the situation where the grounds for awarding an annuity to the injured person constitutes increase in the needs manifesting in the future recurrent expenses covering among others the necessary care, physical therapy, it is enough that the injured party demonstrates the existence of the increased needs being a consequence of tort. The injured person's claim based on such grounds is not a recourse claim against the person obliged to redress the damage. This is because the injured party may not have the suitable funds for the necessary expenses at a given time.

When asserting claims related to an annuity for increased needs, the scope of the increased needs and the probable period in which they will occur should be evidenced, mainly by means of doctors' opinions if necessary. Both the type and extent of the injured person's increased needs and the amount of the related loss in the form of increased expenses depend on individual considerations of the injured party's situation. The amount of the loss suffered by the injured person will be individualised, among others due to a different availability and price of particular services and products applicable in a given location¹³. The Supreme Court's position¹⁴ on covering increased needs consisting in the necessity to use third party's care, where the Court decided that the injured person's right with this respect does not depend on proving that the injured person has effectively spent relevant amounts on care costs, ought to be invoked here. The circumstances where an injured person was cared for by his or her household members does not deprive the person of the right to claim an annuity increased due to that. The principle invoked in the British law providing that the claimant may claim damages for the costs of care provided free of charge by their friends or relatives can be mentioned in addition to the discussions on covering care costs. Yet the damages amount is based in such cases on the costs of commercial care provided with a discount of, normally, 25%-33%. The discount reflects the free family nature of the care and the fact that the carer does not need to incur costs such as taxes, social insurance, or commuting to work. The Polish law does not apply this rule arguing that the fact of providing such care by family members does not mean that the situation cannot

¹¹ Cf. Supreme Court in its judgment of 11 March 1976 (file ref. no. IV CR 50/76, OSNCP 1977, no. 1, item 11).

¹² In the judgment of 22 June 2005 (file ref. no. III CK 392/04, LEX no. 177203).

¹³ Judgment of the Supreme Court of 22 June 2005 (file ref. no. III CK 392/04, LEX no. 177203).

¹⁴ Judgment of the Supreme Court of 4 March 1969 (file ref. no. I PR 28/69, publ. OSNCP 1969, no. 12 item 229).

change and the injured person will not be forced to buy such care on the market (e.g. due to a divorce or illness of the carer).

In accordance with the adopted practice, the amount of the annuity from the Social Insurance Institution (ZUS) and a change of its amount directly influence the amount of the so-called compensatory benefit. The compensatory benefit amount is reduced by the annuity amount. Therefore, any change in the amount of the annuity received by the injured party from ZUS needs to be taken into account.

2. Component identification + discussion on valuation

Hence, when determining the amount of an annuity for increased needs, any costs involved in the loss sustained, which must be incurred cyclically, need to be assessed and the time of incurring them needs to be identified. The court is not obliged to make specific calculations. For that matter, such detailed calculations are simply impossible. The point is to estimate the expenses. The amount of the annuity in respect of increased needs is influenced by:

- 1) the costs of treatment (hospitalisation and surgeries) and doctor appointments,
- 2) the costs of care,
- 3) the costs of medicines, vitamin preparations and ointments, sanitary hygiene products,
- 4) the costs of an individual physical therapy at home and one provided in centres, clinics against payment (e.g. classes at the swimming pool),
- 5) the costs of travel to rehabilitation camps and sanatoriums,
- 6) the costs of the loved ones' travels to the hospital for visits during the injured person's stay;
- 7) the costs of the appropriate diet, e.g. purchase of fruit, juices, products supplementing food in protein, calcium, etc.,
- 8) the depreciation of equipment: a wheelchair, anti-bedsore pillow and mattress, crutches, prostheses, physical therapy devices, aids and equipment, as well as the costs of purchase of a car and car equipment for the disabled and its maintenance costs covering repairs, fuel, insurance, etc.,
- 9) the costs of care, home help related e.g. to doing the shopping, cleaning the flat, doing everyday minor household chores,
- 10) the necessity to take private lessons by the injured person who is a student due to him or her lagging behind in learning,
- 11) any other costs required for compensating the loss.

Re. 1. In the case of planned or expected surgeries, also their costs need to be taken into account. The information provided at <http://www.surgeryprice.co.uk> were used to demonstrate the costs of such surgeries (Table 1)

Table 1. Prices of selected surgeries as at 2016 (in euro)

ACL (ligament) Reconstruction ¹⁵								
LT	LV	FR	DE	IE	NO	PL	GB	CZ
3,000	3,700	6,500	5,500	6,800	10,200	3,00	7,500	---
Hip Surgery								
LT	LV	FR	DE	IE	NO	PL	GB	CZ
3,800	---	11,000	10,500	15,700	10,000	4,500	11,800	7,100
Knee Arthroscopy								
LT	LV	FR	DE	IE	NO	PL	GB	CZ
1,500	2,200	3,600	1,300	---	---	1,200	6,400	1,200

Source: Own work based on <http://www.surgeryprice.co.uk>

The calculation of the costs involved in hospitalisation can be aided by the data regarding the hospitalisation costs in public hospitals. The costs of doctor appointments can be calculated in a similar manner. For instance, Table 2. Part II contains average costs of one doctor appointment in selected countries in 2016. The diversity of the medicine and medical service prices is illustrated also in table 2. The same Table provides also the price of a typical procedure before a surgery, i.e. an X-ray.

Table 2. Prices of medicine, check-up and X-ray 2016 (in euro)

AU	BG	CZ	FI	FR	GR	HG	IE	IT	NL	PL	RO	RS	ES	TR	GB
Aspirins, 100 tablets (supermarket)															
12.64	1.89	16.07	18.68	13.40	8.79	14.44	14.37	26.37	7.97	17.56	14.53	34.93	26.65	1.37	15
Routine check-up at family doctor (av)															
87.36	22.47	102	124	74.18	41.21	88.16	68.68	132	58.79	36.26	22.71	174	335	172	227
One X-ray at doctor's office or hospital (av)															
151	15.45	124	153	65.93	54.95	44.08	118	192	93.41	23.54	23.40	135	2012	75.60	311

Source: Own work based on <https://www.emis.com> – information from Healthcare Report for each countries

¹⁵ For example: Physical therapy starts right after the ACL surgery because it is essential to the healing process. Short-term recovery is normally achieved in 2 months, meaning that a person gradually regains strength and motion of the knee as well as ability to straighten it. Full recovery, in turn, is expected in 6 months.

Re. 2. In this case, it needs to be determined, in accordance with the doctor's opinion, how much time (days, months, or years) the injured person needs to be aided by nurses or cared for. The determination of such a cost can be based on the value of the average rate per hour of work in a given occupation (in Poland, a nurse is occupation no. 222, the average 2014 rate was as presented in Table 3).

Table 3 Average gross hourly wage of a nurse in Poland in 2014 (PLN/EUR)

Public sector			Private sector		
in total	M	F	in total	M	F
19.65 / 4.80	20.10 / 4.90	19.64 / 4.80	17.89 / 4.36	20.84 / 5.08	17.87 / 4.36

Source: after the Central Statistical Office of Poland (GUS)¹⁶

The day care costs can be calculated based on the cost of such care in social welfare centres. In some City Social Welfare Centres (MOPSS) in Poland, the cost of 24/7 care is based on the minimum pension level, e.g. day care cost in the Wrocław MOPS is 2.3% of the minimum pension amount, thus the Monday-Friday rate was PLN 19 (EUR 4.6), and the holiday rate was higher – PLN 20.25 (EUR 4.9) in 2014. Obviously, like for any value assumed for estimation, it needs to be taken into consideration that the hourly care rate in MOPSSs can differ between the regions of the country, not to mention the differences across Europe. For example, the hourly day care rate in Warsaw (MOPS Warszawa-Żoliborz) was PLN 10.38 (EUR 2.5), in Chełm – PLN 8.75 (EUR 2.1), and in Koszalin – as much as PLN 26.15 (EUR 6.4) in 2016. It needs to be stressed that these are the lowest rates on the market – private centres charge higher rates.

Re. 3. When determining the value of the funds needed for purchasing medicines in the future, one needs to remember (like in each of the discussed points, as mentioned in the methodology) about inflation and amendments to the law regarding the lists of reimbursable medicines. It needs to be borne in mind that it is only the persons covered by the social insurance system that can benefit e.g. from discounts for medicines or subsidies. It also needs to be emphasised that there is a prescription charge in some countries (e.g. in Great Britain). The differences in medicine costs are illustrated by the price of 100 aspirin pills provided in Part I of Table 3.

Re. 4. The costs of physical therapy are also significant for the amount of the discussed annuity. Such costs were, for instance, PLN 110 (EUR 24.4) per hour¹⁷ on the Warsaw market in 2016.

¹⁶ <http://stat.gov.pl/obszary-tematyczne/rynek-pracy/pracujacy-zatrudnieni-wynagrodzenia-koszty-pracy/struktura-wynagrodzen-wedlug-zawodow-w-pazdzierniku-2014-r-,4,7.html>

¹⁷ <http://www.mobilemed.pl/cennik/>, <https://www.damian.pl/centrum-rehabilitacji/rehabilitacja-w-domu/>

In this case it is also necessary to determine, based on the doctor's opinion, the period (number of days, months, or years) in which the injured person will need to be supported by physical therapists. An intensive several months' physical therapy is required after virtually every surgery resulting from an accident. In the case of hospitalisation, the number of days of the hospital stay must be calculated.

Re. 5. This component is also necessary for convalescence. It needs to be remembered that, due to a considerable improvement of the standard in sanatoriums, the price for a stay has significantly increased, now being approximately 30% higher than 5 years ago.

Re. 6. When calculating this factor, one may use the lump-sum rates set for travel in the public administration. The frequency of visits, in turn, could be regulated by principles like e.g. in the USA.

Re. 7. This point speaks of both a special diet (e.g. enteral nutrition) and simply a varied diet which, owing to its positive psychological influence on the patient, accelerate the healing process. It must be borne in mind that the calculation of this portion of the annuity should include only the nutrition elements which have been added to the diet, not its total daily cost. This can be achieved, for example, through creation of a basket of goods to be added to the daily diet. The basket ought to be valued at the cost of the products applicable in the country from which the injured person comes.

Re. 8. The costs of a wheelchair, anti-bedsore pillow and mattress, crutches, protheses, physical therapy devices, aids and equipment, as well as the costs of purchase of a car and car equipment for the disabled could be taken into account in an annuity in respect of increased needs by including the amount of equipment depreciation in a given period in the periodic payment. For instance, the estimated cost of purchasing a typical wheelchair is PLN 510-3,000¹⁸ (ca. EUR 120-730) in Poland, the cost of an electric wheelchair is ca. PLN 7,500 (ca. EUR 1,830), and its depreciation period is 4 years¹⁹.

Re. 9. In the situation where the accident victim is unable to perform the household chores they used to do before the accident, the annuity should include also the funds required to employ a home help. Like in the case of care for the injured party, if some or all chores can be taken over by the injured person's family members, this does not release the injuring party from the obligation to provide the injured person with the funds enabling the purchase of such a service on the market. The cost can be determined based on the statistical data of the average hourly

¹⁸ After: <http://www.gtmobil.com.pl/dofinansowania>

¹⁹ According to <https://www.pfron.org.pl/pl/komunikaty/2670,Dofinansowanie-zakupu-wozka-inwalidzkiego-ona-pedzie-elektrycznym.html>

rate in a given occupation (in Poland, code 911 corresponds to the profession Home, Office and Commercial Helps and Cleaners, and code 512 - to Cooks, the average 2014 hourly rate for work in these occupations was as indicated in Table 4).

Table 4 Average hourly gross remuneration of a nurse in Poland in 2014 (PLN/EUR)

	Public sector			Private sector		
	in total	M	F	in total	M	F
Home help	12.26 / 2.99	13.62 / 3.32	12.19 / 2.97	10.91 / 2.66	10.90 / 2.66	10.92 / 2.66
Cook	13.07 / 3.19	14.63 / 3.57	12.98 / 3.17	11.57 / 2.82	12.27 / 2.99	11.07 / 2.7

Source: after GUS²⁰

Re. 10. This annuity component is temporary but its significance can be two-fold. It can be granted for the time when a child has a break from school resulting from being hospitalised or staying at home after a surgery or in a sanatorium. In such a case, private lessons are supposed to help the child catch up and prepare him or her to return to school. Or when the child is unable to go back to school, this ought to be the cost of substitute teaching.

Re. 11. The list of annuity components may be from time to time extended by untypical individually added components. As an example of the expenses which could be disbursed as part of the annuity²¹, the judgement of the court which allowed for the costs of a preparation used for treating erectile dysfunctions in adult men consisting in the inability to achieve or maintain an erection sufficient for a satisfactory sexual intercourse could be invoked. As was decided by the court, the judicial and sexological opinion prepared by the expert sexologist provided that the claimant had a regular sexual life, a regular partner with whom he had sex 1-2 times a week using a special preparation which would not have been necessary if it had not been for the accident, and the monthly costs of the medicine amounted to PLN 240. Therefore, in the court's opinion based on experts' opinions, it needs to be stated that the quantity and value of the purchased substance over the period defined by the claimant was representative for planning the costs involved in purchasing the preparation in the future and the expenses must be included in the annuity for increased needs of the injured party.

²⁰ <http://stat.gov.pl/obszary-tematyczne/rynek-pracy/pracujacy-zatrudnieni-wynagrodzenia-koszty-pracy/struktura-wynagrodzen-wedlug-zawodow-w-pazdzierniku-2014-r-4,7.html>

²¹ A substantiation of the judgment of the Appeal Court in Lublin of 25 June 2009 (file ref. no. I ACa 272/09, unpublished)

3. Methodology of determining the value of the annuity

This section of the article will propose the concept of estimating the size of the annuity for increased needs. The model will be based on financial mathematics (time value of money) and actuarial mathematics (life annuity). The size of the annuity will be approximated by its present value. Knowing what is the present value of future payouts is important for two reasons. First, the person responsible for paying the annuity (the insurer or individual person) must have a capital reserve for this payment. Secondly, in some countries it is possible to replace the interim payment (that is, in the form of a annuity) and receive a one-time payment from the victim. The injured himself manages the capital and cares about his needs in the future. Knowledge about the present value of annuity will allow the injured person to determine the amount of capital that he will demand in return for interim payments.

Due to the long time horizon of disability benefits, the time value of money should be included in the calculation. In the annuity model will therefore be taken into account inflation (increasing annuity). The author suggests to use the average inflation rate for a period of 10 years from the state. And if possible, take the exact level of inflation - for the elements related to medical services, medicines, etc. to accept inflation for that area, while for calculating the cost of the diet you can assume the general inflation rate. With respect to nursing services and domestic help, the index of salary increase may be used for indexation.

In calculation the present value of an annuity, it is necessary to take into account the discounting of individual amounts - in line with the principle of the time value of money. The author proposes to make an assumption: the average technical rate in each country as the discount rate or the average rate of long-term government bonds.

The valuation will be based on the actuarial annuity, so it will take into account the probability of the victim surviving the next payment. The model also has a simplified assumption that payments are paid to the injured person once a year. This is related to the construction of life tables. The tables include probability of survival to the next year. It is possible to use methods that allow to calculate the probability of reaching a part of the year (eg assumption about uniformity of death distribution, assumption about constant intensity of mortality, Balducci's assumption²²). Payment split for months is just a simple detail of the method.

It is assumed that the victim receives the payment at the beginning of the following years. The duration of payment of the annuity is dependent on the victim's condition. In some cases (temporary and reversible harm to health), this will be a term annuity and sometimes a whole

22 More in: Bowers N.L., Gerber H.U., Hickman J.C., Jones D. A., Nesbitt C.J. "Actuarial Mathematics" The Society of Actuaries, 1986

life insurance (with serious irreversible damage to health such as disability). The amount of payment depends on the cost that the victim will pay in a given year. The calculation should be preceded by the physician's findings on the course of treatment (surgery, rehabilitation, care, medication, etc.).

Taking into account all these assumptions²³, it can be assumed that the present value of a pension will be calculated on the basis of the treatment program, the course of the disease or the treatment prepared by the physician. The present value of the pension can therefore be described by the formula:

$$PV = \sum_{k=1}^n (1+i)^{k-1} v^{k-1} {}_k p_x A_k$$

A_k – the amount of annual expenses for the first year of the pension, the value determined according to the prices of goods and services in force in the first year of the pension

x – age of the victim at the time of calculation of annuity

${}_k p_x$ - probability of survival for the victim to the next payment of annuity

n – number of years for that the annuity is calculated

i – annuity indexing rate (eg. the average inflation for a long period)

$v = \frac{1}{1+r}$; where r – discount rate (eg average long-term technical rate or YTM rate for 10-year treasury bonds)

The author is aware that for severe illness and related health impairment, it should be used in the calculation of life tables for people with disabilities. The probability of surviving each year in the situation of people with disabilities is often lower than for people without disabilities. However, I have no access to such life-time tabs.

Here are two examples showing the possibility of calculating a pension for a short time and for whole life. They include a proposal for a calculation PV annuity and possible ways to pay.

Example 1.

The 25-year-old Pole - a man living in Ostrołęka who was not socially insured - suffered an accident. A knee operation is required in the first year. It was found that the annuity will be calculated for 3 years, after this time the injured person will return to health according to the doctor's opinion. The following assumptions were made for the calculation:

²³ In this model, a common inflation rate was adopted for all costs

- surgery: surgery of the knee ligaments (cost according to hospital price list in Ostrołęka²⁴ it's 8 379 PLN = EUR²⁵ 2 043.66)
- hospitalization: the first year the victim will stay in the hospital about 30 days, in 2 and 3 years after 4 days (the cost of a day's stay in a hospital in Poland is, for example, PLN 624 = EUR 152.20, from a hospital in Poland Ostrołęka²⁶)
- medicines: In the first 6 months, the injured will take medication with a monthly value of 100 PLN = EUR 24.39, in the next months 50 PLN = EUR 12.20. Medicines will be taken for 2 years
- Medical visits: the victim once a month has to have a follow-up visit. For 3 years. One time cost advice in accordance with hospital price list in Ostrołęka²⁷ is 53 PLN = EUR 12.93.
- Care: for the first 6 months the injured person needs care 2 hours daily (cost of care according to the hospital price list for the one hour of surgical nurse²⁸ is 24 PLN = EUR 5.85)
- rehabilitation: for the first 3 months, the rehabilitation needs 3 hours a day, then the end of 1 year after 6 hours a week, 2 years requires rehabilitation 15 hours a month, and 3 years requires rehabilitation 10 hours a month. An hourly cost of rehabilitation in accordance with the price list²⁹ is about 20 PLN = EUR 4,88.
- sanatorium: the second year is planned to leave the injured to the sanatorium is 170 PLN = EUR 41.46 per day, stay in sanatorium is 2 weeks. The cost of travel to sanatorium is 200 PLN = EUR 48.78.
- arrivals of family members to the hospital: the victim has a wife and 2 children, they go to visit the victim together by the one car. It was assumed that someone would come to visit every day. The model of the car is known (which will allow for the flat rate for the ride) - it is a car with engine capacity up to 900 cm³. Distance to the hospital is 8 km one way. According to the flat rate³⁰ cost for 1 km is 0.5214 PLN = EUR 0.13.
- diet: for the first 6 months the victim will eat a diet rich in calcium and fruit. It was assumed that price of a daily diet is about 8 PLN = EUR 1.95 more than the traditional diet.
- There are no plans to purchase orthopedic equipment, nor is there a substitute for home work.

²⁴ price list, code 81.45/1: <http://www.szpital.ostroleka.pl/userfiles/Cenniki/cennikusugmedycznych-2017.pdf>

²⁵ The rate: 1EUR = 4,1 PLN.

²⁶ price list, code 009: <http://www.szpital.ostroleka.pl/userfiles/Cenniki/cennikusugmedycznych-2017.pdf>

²⁷ price list, code 02.01: <http://www.szpital.ostroleka.pl/userfiles/Cenniki/cennikusugmedycznych-2017.pdf>

²⁸ price list, code 008: <http://www.szpital.ostroleka.pl/userfiles/Cenniki/cennikusugmedycznych-2017.pdf>

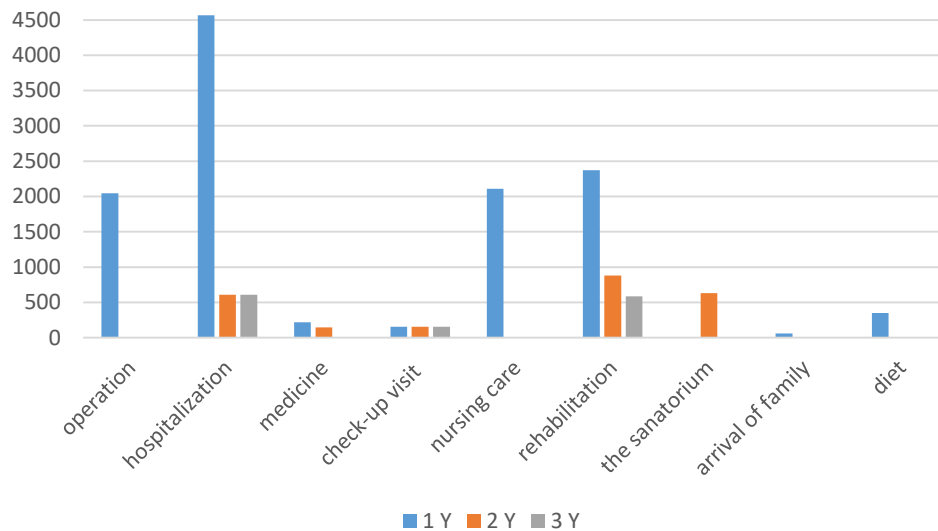
²⁹ price list, code 93.0: <http://www.szpital.ostroleka.pl/userfiles/Cenniki/cennikusugmedycznych-2017.pdf>

³⁰ Regulation of the Minister of Infrastructure of March 25, 2002 on the terms of determining and how to reimburse the costs of using non-employer cars, motorcycles and mopeds for business purposes, Dz.U. 2002 nr 27 poz. 271: <http://isap.sejm.gov.pl/DetailsServlet?id=WDU20020270271>

The assumptions are as follows: in Poland inflation in the last 10 years (2005 - 2015) was at an average level of 2.53%, the rate of 10-year treasury bonds was 1.44%.

First, the cost values (inflation indexed) were calculated in each year according to the cost and scenario proposed in the example (chart 2). And then the present value of the pension is calculated: EUR: 15.703,95.

Chart 2. Costs by category of needs, taking into account inflation, for particular years.



Source: own calculation

Example 2.

The 25-year-old Pole - a man living in Ostrołęka who was not socially insured - suffered an accident. It is necessary to amputate both legs in the first year. It was established that the annuity will be paid for whole life. The following assumptions were made for the calculation:

- surgery: amputate both legs (cost according to hospital price list in Ostrołęka³¹ is 1,351 PLN = EUR 329.51 for one leg)
- hospitalization: the first year the victim will stay in the hospital about 60 days and then every 5 days (the cost of a day's stay in a hospital in Poland is, for example, PLN 624 = EUR 152.20, from a hospital in Poland Ostrołęka³²)
- medicines: In the first 6 months, the injured will take medication with a monthly value of 150 PLN = EUR 36.59, in the next months 50 PLN = EUR 12.20. Medicines will be taken for whole life.

³¹ price list, code 84.172: <http://www.szpital.ostroleka.pl/userfiles/Cenniki/cennikusugmedycznych-2017.pdf>

³² price list, code 009 : <http://www.szpital.ostroleka.pl/userfiles/Cenniki/cennikusugmedycznych-2017.pdf>

- Medical visits: the victim once a month must have a visit to the control, for the rest of his life. One time cost advice in accordance with hospital price list in Ostrołęka³³ is 53 PLN = EUR 12.93.
- Care: for the first 2 years the injured needs 5 hours of daily care, in the following years such care should be taken 6 hours a week (cost of care according to the hospital price list for the one hour of surgical nurse³⁴ is 24 PLN = EUR 5.85)
- rehabilitation: for the first 3 years the victim needs rehabilitation 3 hours a day, then the end of 10 years 6 hours a week and then 10 hours a month for whole life. An hourly cost of rehabilitation in accordance with the price list³⁵ is about 20 PLN = EUR 4,88.
- sanatorium: the 2th, 7th, 12th and 17th years is planned to leave the injured to the sanatorium is 170 PLN = EUR 41.46 per day, stay in sanatorium is 2 weeks.. The cost of travel to sanatorium is 200 PLN = EUR 48.78.
- arrivals of family members to the hospital: the victim has a wife and 2 children, they go to visit the victim together by the one car. It was assumed that someone would come to visit every day. The model of the car is known (which will allow for the flat rate for the ride) - it is a car with engine capacity up to 900 cm³. Distance to the hospital is 8 km one way. According to the flat rate³⁶ cost for 1 km is 0.5214 PLN = EUR 0.13.
- diet: whole life the victim will eat a diet rich in calcium and fruit. It was assumed that price of a daily diet is about 8 PLN = EUR 1.95 more than the traditional diet.
- purchase of orthopedic equipment: plans to purchase a wheelchair every 5 years (in 1th, 6th, 11th, 16th, 21th, 26th, 31th, 36th and 41th years of annuity). The cost of buying a wheelchair is about 3000 PLN = EUR 731.71. Included not as a one-time purchase and as depreciation of equipment.
- domestic help: the injured needs housework (cleaning, laundry and shopping) 10 hours a week, and after 60 years old (ie after 35 years of paying the rent) needs help 15 hours a week. The cost of domestic work hours in Poland is as indicated in Table 3 - 10.90 PLN = EUR 2,66 (the lowest bid was chosen).

The assumptions are as follows: in Poland inflation in the last 10 years (2005 - 2015) was at an average level of 2.53%, the rate of 10-year treasury bonds was 1.44%.

³³ price list, code 02.01: <http://www.szpital.ostroleka.pl/userfiles/Cenniki/cennikusugmedycznych-2017.pdf>

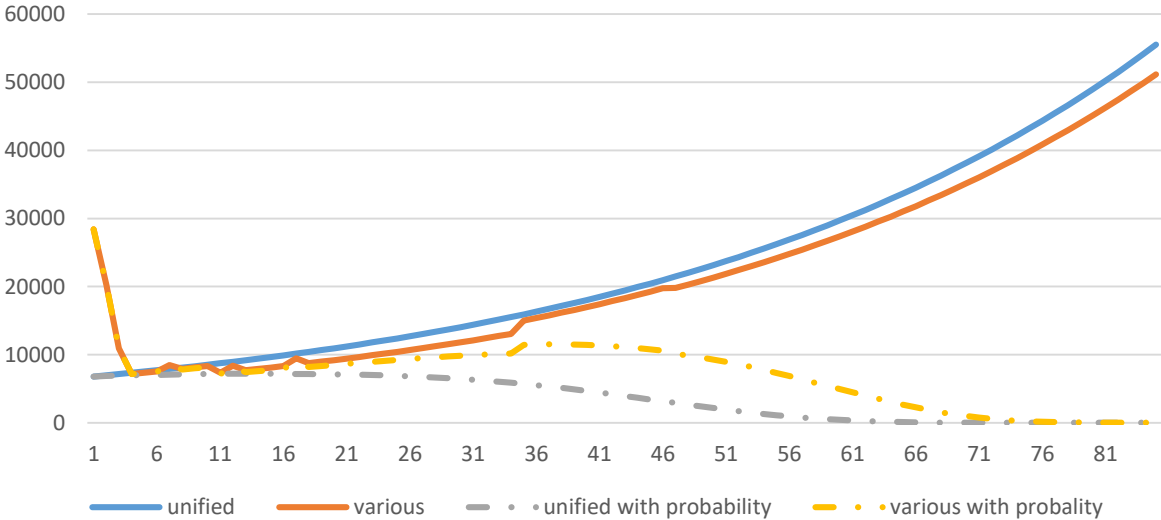
³⁴ price list, code 008: <http://www.szpital.ostroleka.pl/userfiles/Cenniki/cennikusugmedycznych-2017.pdf>

³⁵ price list, code 93.0: <http://www.szpital.ostroleka.pl/userfiles/Cenniki/cennikusugmedycznych-2017.pdf>

³⁶ Regulation of the Minister of Infrastructure of March 25, 2002 on the terms of determining and how to reimburse the costs of using non-employer cars, motorcycles and mopeds for business purposes, Dz.U. 2002 nr 27 position. 271 in: <http://isap.sejm.gov.pl/DetailsServlet?id=WDU20020270271>

The present value of the pension (in the horizon of 85 years, due to the fact that life tables are given up to 110 years) is 405,216.30 Euro. The use of an actuarial annuity (life expectancy based) is justified because another payout is only provided that the victim is still alive. The present value of the annuity without taking into account the probability of survival would be 895,152.36 Euro. The sequence of individual payouts in retirement is presented in Chart 6. Based on this example, you can also discuss the way you pay the annuity. It can be paid according to needs in a every year (various version). The other way is to standardize payouts (unified version). Determine the size of the first payment so that by then indexing the inflation rate for each successive year for 85 years you use the total PV. In this situation, the first year the victim of example 2 should receive 6,806.68 Euro. Matching both of these methods is also shown in chart 3.

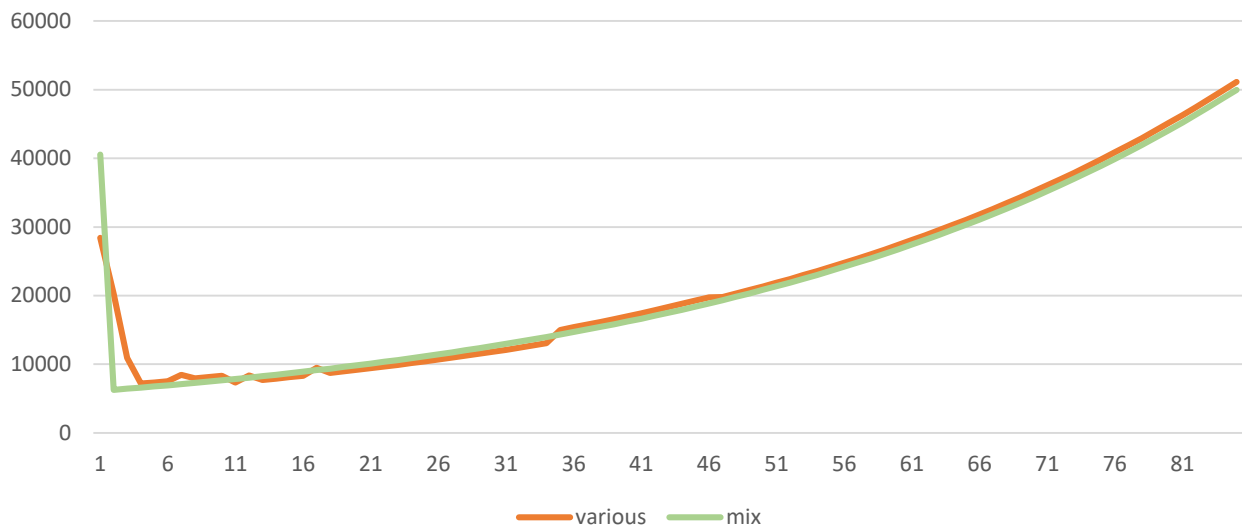
Chart 3. Nominal value of annual payments without discount, with inflation indexation



Source: own calculation

Because of the specific needs that cover the disability pension (the highest cost is the medical treatment planned in the first treatment period), there is also a mixed option (mix version). For example, the payment of 10% PV of the annuity in the first year and the remainder of the payment in installments equal to the indexation of inflation. Such a variant is shown in chart 4. As you can see, this method of payment is better adapted to the needs of the victim and at the same time easy to pay.

Chart 4. Nominal value of annual payments without discount, with inflation indexation in unified and mix version



Source: own calculation

It is worth remembering that because of the long time horizon of disability benefits, their amount can be changed during the time of paying the annuity. They may have more needs, which are the result of the accident. In such a situation the perpetrator of the damage should also be responsible for them.

4. Conclusions

The article was intended to discuss the possibility of calculating the amount of capital needed to cover the increased needs of the victim after an accident. Costs related to increased needs are the financial consequences of personal injury. Increased needs connected with the loss of health (permanent or temporary) are only one of several financial consequences after an accident. It also exchanges:

- lost income - temporary or permanent inability to work for the victim, or the need to change jobs to another maybe lower pay. The victim should receive an annuity that covers his lost income (in all or in appropriate part).
- harm associated with pain and suffering resulting from the disease. In this situation, the injured person should receive compensation.

Considerations for only one component of compensation for the financial consequences of personal injury (pensions for increased needs) show that these effects are not small. First shown multiplicity of factors and components that need to be taken into account in calculating the

annuity. Then was proposed what economic quantities (prices, rates, etc.) can be helpful in annuity valuation. And finally was proposed a method consistent calculation of the annuity in order to know its current value.

The examples presented how to calculate the compensation annuity. In addition, the second example shows the magnitude of the problem of increased needs as a result of serious accident and serious injury. Calculated annuity and disbursed to homogeneous annual payments, which in the future to be indexed by the inflation rate gave an annual value of 6,806.68 Euro. In Poland in 2016 the average monthly salary was 4,277 PLN = EUR 1,043.17, ie the average annual salary was 51,324 PLN = 12,518.05 EUR. This means that the increased needs after an accident can reach half of the average annual salary.

Finally, it should be noted that the most common source of personal injury financing are civil liability insurance, and especially motor vehicle owners (MTPL). Due to the high and still increasing value of these damages, the European Commission adjusts the minimum guarantee sums (based on Directive 2009/103/EC³⁷ of the European Parliament and the council of 16 September 2009 relating to insurance against civil liability in respect of the use of motor vehicles, and the enforcement of the obligation to insure against such liability). According to Art. 9 sec. 2, one of the tasks of the European Commission is to valorize the amounts specified in the Directive according to the current inflation rate. Once every 5 years, it reviews the quotas to take account of changes in the European Consumer Price Index covering all Member States and published by Eurostat. From 2017 in the European Union the following guarantee sums are applicable in the event of personal injury of EUR 1,220,000 per victim and EUR 6,070,000 per one road accident³⁸.

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