Differences in the Values of Life Tables Created for both Sexes Combined and Separately

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Poznan University of Economics, Poznan, Poland
anna.klimas@ue.poznan.pl

Life insurance is a form of collateral in a situation of financial changing and a form of saving. The amount of net premiums is based, among others, on a life table for a given cohort. The main objective of this article is the influence of difference on the values of life tables that are created for both sexes together and separately on the amount of single net premiums in life insurance. The example considered in this article is an endowment insurance. The secondary aim is to draw attention to the form of savings in the period of inability to work. The additional security that is presented here draws attention if it is better to enter into an agreement for a longer period of insurance or not.

This article covers life tables that were created for both sexes combined in the period 1990-2012 but also created for both sexes separately in the years 1998-2012 and on the same population. It also considers endowment insurance products with the possibility of its use as collateral. All undertaken analysis and data that are presented in this article relate to Poland.

In chapter 1 there are shown life tables where particular attention is put to factors, that affect the values of tables. Chapter 2 describes a single net premium in life insurance and its construction. It also refers to the example which is a leading point in the article. The next Chapter 3 presents the situation of a single net premium of endowment insurance in the analyzed period. The factor that differentiates sex has been also adopted in the chapter. The difference in the values and the impact of the factor on a single net premium was analyzed. Similarly, in chapter 4 there was analyzed the impact on the amount of single net premiums when a sex was not differentiated.

The life table

Life tables are created for both sexes and separately for women and for men. They illustrate the indicators characteristic to the society. Numbers which are contained in the tables describe a process of extinction of a cohort. Thus, from birth until death, it usually takes the interval <0.100>. Tables are constructed on the basis of different age groups in the given time interval and using biometric functions. The size of content in life tables is updated, because life tables are subjected to constant changes associated with the development of medicine, health and standard of living (Dobija & Smaga, 1995). They are an important instrument for risk assessment, and also for calculation of premiums and reserves in a life insurance (Królikowski, 2006). In Poland life tables are determined each year by the Central Statistical Office (GUS).

Single net premium in life insurance

In a life insurance the basic insured event is a death or survival to a stipulated age of an insured person. The measure of risk of the analyzed insurance is the probability of death, which depends on factors such as age of the insured person, residence, health status, occupation and sex. According to Wieslaw Krolikowski, „*life insurance is a device that stabilizes life and allows to maintain the economic balance among human groups while situations of increased spending or reduced revenues take place due to various random events*" (Królikowski, 2006).

The fixed premium of life insurance does not correspond to the risk of death, because with the increase of age the premium would increase as the risk of death increases. In insurance practice a uniform premium on a certain level is used, which is created as an averaged risk for the entire period of insurance. In the initial period of insurance the amount of a uniform premium creates an surplus of the risk, but in the later period this difference has the opposite situation. The surplus of premium of the risk creates mathematical reserve, which is later compensated and intended for future liabilities of the insurer. The uniform premium consists of the investment portion of the premium, which is the aforementioned reserve, and the risk premium, which is a part that is intended for present liabilities of the insurer.

In the article the analyzed type of life insurance is an endowment insurance. Such insurance has exclusively an economic character. The purpose of the analysis of the selected insurance is to show the way of additional security in a case of incapacity to work, so for the time of retirement. Till 2013 the retirement age in Poland was 60 for women and 65 for men. From 2013 the retirement age has been enlarged for 1 month and for both sexes every 4 months. In this way the retirement age will reach 67 for men by 2020, and for women by 2040. Therefore, considering the use of such insurance as a form of savings for future years, is it better to insure oneself at the younger age for a longer period of insurance or at the older age but for a shorter period. The situation is illustrated in the graph below.

Graph 1. The amount of single net premium endowment insurance for 65-years for women and men aged 30, 35, 40, 45, 50, 52 years
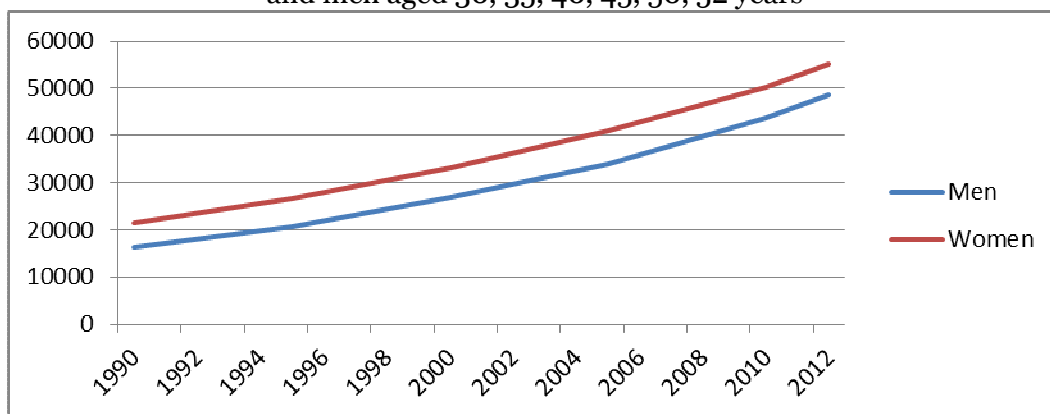
Source: Own study based on data from GUS

The graph above shows the situation of endowment insurance for the sum of 100 000 considering:
- In 1990, for a person at the age of 30 for an insurance period of 35 years,
- In 1995, for a person at the age of 35 for an insurance period of 30 years,
- In 2000, for a person at the age of 40 for an insurance period of 25 years,

- In 2005, for a person at the age of 45 for an insurance period of 20 years,
- In 2010, for a person at the age of 50 for an insurance period of 15 years,
- In 2012, for a person at the age of 52 for an insurance period of 13 years.

Taking into consideration only life tables the difference in the amount of premium is very evident for both sexes, men and women. Figure 1 shows the increase of amount of premium along with the increase of age of the insured person in a situation where the insurance period is being gradually reduced. Thus, it can be concluded that the insurance at the younger age for a longer period of coverage is more favorable than at the older age for a shorter insurance period. However, in this type of life insurance the insured person bears the risk related to living to a certain age.

Single net premium in the endowment insurance for the period 1990-2012 for one sex

The endowment insurance, as mentioned in Chapter 2, is the only insurance concerning savings. It relies on insurance payment premiums paid during a period of time or it is paid only once when concluding the insurance contract. If the insured survives the insurance period that was determined in the time of concluding the insurance contract, the benefit will be paid out. The insured shall bear the risk of death during the term of the insurance contract. If this risk occurs during the period of insurance, the benefit will not be paid out (Królikowski, 2006).

Let $A_{x:\overline{n}|}^{1}$ mean a single net premium of endowment insurance for people at the aged of x years for an insurance period of n years. Let us assume also that the insured sum is 1j. Let i mean the technical interest rate, and $v = \frac{1}{1+i}$ is the discount factor. Then the formula for a single net premium of endowment insurance is:

$$A_{x:\overline{n}|}^{1} = v^{n}\,_{n}p_{x},\qquad\qquad(1)$$

where $_{n}p_{x}$ means the probability that a person aged x might survive at the aged of $x + n$ years (Kowalczyk, Poprawska & Ronka-Chmielowiec, 2006).

This article analyzes the example of endowment insurance for a person at the age of 30 with the insurance period of 35 years. Concerning the above example the analysis is intended to show how changes in the values of life tables from the period of 1990-2012 affect the amount of a single net premium. For such considerations the fixed technical interest rate was assumed for each year and equals to 4%. The maximum of technical rate is established and announced every year by the supervisory authority which is The Polish Financial Supervision Authority. According to the Regulation of the Minister of Finance dated to 28 December 2009 insurance companies can not determine any technical rate which is higher than the fixed maximum technical rate for a current year (Rozporządzenie Ministra Finansów z dnia 28 grudnia 2009 r. w sprawie szczególnych zasad rachunkowości zakładów ubezpieczeń i zakładów reasekuracji, 2009). The following table shows amounts of single net premiums in each year with the insurance sum of 100 000.
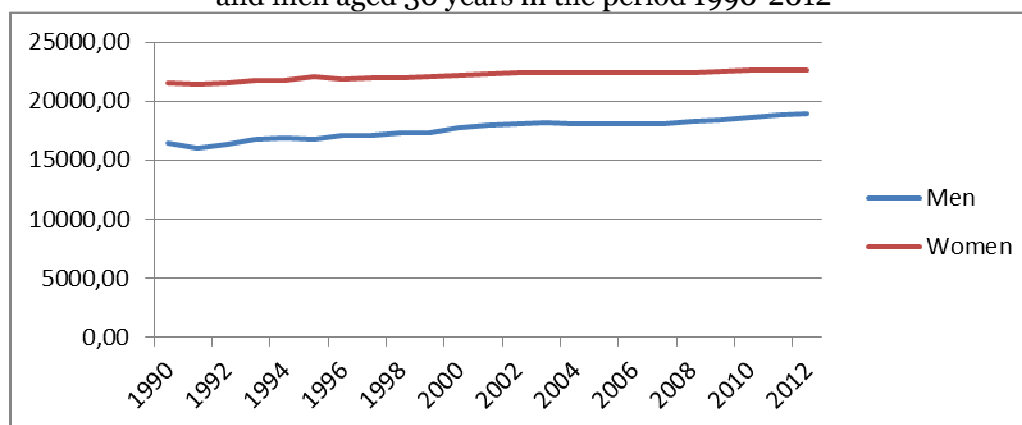
Table 1. The amount of a single net premium endowment insurance for 35 years for women and men aged 30 years in the period 1990-2012

	Men	Women	Difference
1990	16407,32	21509,09	5101,76
1991	16034,72	21438,74	5404,02
1992	16345,96	21549,28	5203,33
1993	16724,89	21736,97	5012,08
1994	16906,87	21782,69	4875,82
1995	16812,94	22114,12	5301,18
1996	17077,02	21908,52	4831,50
1997	17144,40	21954,47	4810,07
1998	17305,07	22029,74	4724,67
1999	17291,62	22041,95	4750,33
2000	17768,24	22151,19	4382,95
2001	17952,97	22263,56	4310,59
2002	18098,76	22361,96	4263,20
2003	18140,04	22372,62	4232,57
2004	18095,79	22401,09	4305,29
2005	18117,52	22395,63	4278,11
2006	18098,84	22389,70	4290,86
2007	18111,53	22395,23	4283,70
2008	18256,55	22444,53	4187,98
2009	18419,32	22468,18	4048,86
2010	18654,36	22615,08	3960,73
2011	18789,81	22651,37	3861,57
2012	18947,73	22658,82	3711,09

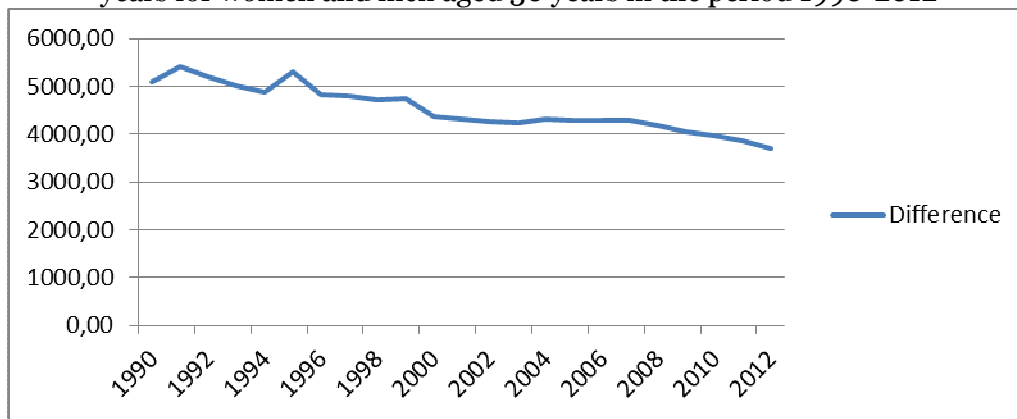*Source: Own study based on data from GUS*

The graph below illustrates the difference in the amount of a single premium for each sex and how the difference of the insurance between men and women changes.

Graph 2. The amount of a single net premium endowment insurance for 35 years for women and men aged 30 years in the period 1990-2012

Source: Own study based on data from GUS

Graph 3. The difference in the amount of a single net premium endowment insurance for 35 years for women and men aged 30 years in the period 1990-2012

Source: Own study based on data from GUS

The above 2 and 3 graphs as well as the table 1 above show that the amount of a single net premium of the analyzed period increased more among men than women. However, for both sexes the amount of a single net premium tends to increase during the entire analyzed period. The difference in the amount of a single net premium for men and women has a downward trend. Therefore, while analyzing the entire period a single net premium for men approaches the value of a single net premium for women.

Single net premium in the endowment insurance for the period 1998-2012 for both sexes

In this chapter there is presented the amount of a single net premium of endowment insurance for a person at the age of 30 for an insurance period of 35 years. Alike in Chapter 3, there has been adopted the technical interest rate that equals to 4% for each year and the insured sum of 100 000. The amount of a single net premium clearly shows how changes of the values in life tables created for both sexes affect the amount of the premium. The following table shows amounts of a single net premium for both sexes.

Table 2. The amount of a single net insurance premiums on endowment 35 years for people aged 30 years in the period 1998-2012

	Men and Women
1998	19612,93
1999	19612,63
2000	19612,63
2001	20055,59
2002	20179,23
2003	20204,23
2004	20195,63
2005	20204,23
2006	20191,52
2007	20200,60
2008	20298,89
2009	20393,12
2010	20585,29
2011	20672,08
2012	20756,45

Source: Own study based on data from GUS

The graph below shows the change in the amount of a single net premium for both sexes.

Graph 4. The amount of a single net insurance premiums on endowment 35 years for people aged 30 years in the period 1998-2012
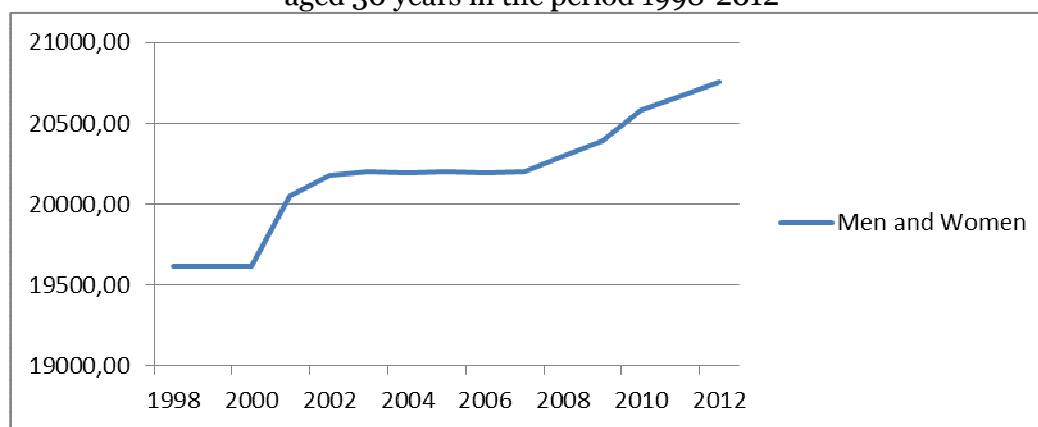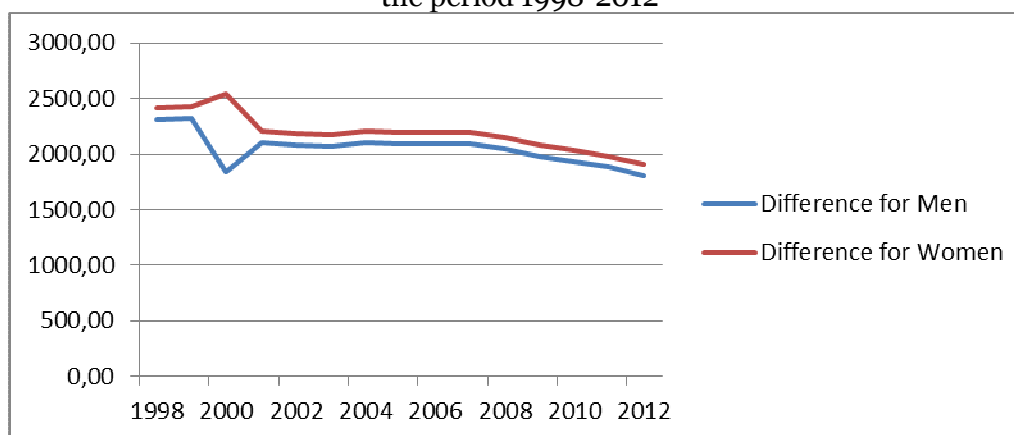

Source: Own study based on data from GUS

In initial years the amount of single net premiums remained at the same level. It was not till 2000 when an upward trend appeared. While comparing 1998 and 2012, the difference amounted even to 1.143,53. Without considering the value of money in a course of time the amount of price for the same service during the last 14 years has changed greatly. The amount of premium reflects the impact of changes in the values of life tables. In the same period, the life expectancy has increased due to higher living standards as well as to development of medicine. In 1998 an average life expectancy of a person at the age of 30 was 44.51 years, while in 2012 it increased to 47.69 years.

Conclusions

Life tables are being created for both sexes combined and separately. However, in accordance with art. 18a of the Act of 22 May 2003 on insurance activity: "*The use by the insurance company gender criterion in calculating insurance premiums and benefits may not lead to differentiation of insurance premiums and benefits of individuals*" (Ustawa z dnia 22 maja 2003 r. o nadzorze ubezpieczeniowym i emerytalnym oraz Rzeczniku Ubezpieczonych, 2003) single net premium in life insurance is calculated for both sexes, and is combined. Comparing the amount of a net single premium for women and men using life tables that are created for both sexes separately from the net single premium for both together can be seen that the difference in the values shows the downward trend in the period 1998-2012. Thus, while comparing years 1998 and 2012 the difference decreased by about 500J. A graph below shows the situation.

Graph 5. The difference in the amount of a single net premiums calculated for both sexes combined and separately in the insurance endowment 35 years for people aged 30 years in the period 1998-2012

Source: Own study based on data from GUS

The type of insurance analyzed in this article has not been chosen without a reason. In Poland the problem of an aging society has been observed for years. What has been also noticed is a higher standard of living, development of medicine and, above all, extension of life expectancy. Thus, the number of Poles decreases, but their life expectancy increases. The pension system existing in Poland has been experiencing a problem with prolonged pension payment and with the significant decrease of people in an economically productive age. Polish society should consider additional ways in order to protect themselves in a case of inability to work, which is the retirement age. One of the possibilities might be the endowment insurance, which is a form of savings.

Chapter 2 of the article presents how the amount of single net premiums can change in accordance with the age of the insured. In the 12 years period the average difference for both sexes was 33 000j., for the analyzed example. For men the premium would increase twice in the period of 12 years. The analyzed example in chapter 2 incorporates division of sexes while taking into consideration life tables for both sexes separately. In conclusion we may emphasize the fact that getting into the economically productive age one should consider additional protection for the period of inability to work. The one should also notice that it is more profitable if we use a longer period of insurance.

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